Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

VEHICLE EMISSIONS INSPECTION AND MAINTENANCE (I/M) PROGRAM

ANNUAL REPORT FOR 1990

DIVISION OF AIR QUALITY CONTROL
ONE WINTER STREET, 7TH FLOOR
BOSTON, MASSACHUSETTS 02108

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September, 1991

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MASSACHUSETTS VEHICLE EMISSIONS INSPECTION AND MAINTENANCE I/M PROGRAM ANNUAL REPORT FOR 1990

I. OVERVIEW

1. INTRODUCTION TO THE I/M PROGRAM

The Clean Air Act Amendments (CAA) of 1977 required each state to determine whether it met health and welfare-related standards for six air pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), total suspended particulates (TSP), nitrogen dioxide (NO_2), lead, and ozone (O_3). States that did not meet federally-established standards for any or all of these pollutants had to devise and implement, subject to the approval of the U.S. Environmental Protection Agency (EPA), a State Implementation Plan (SIP), which documents approved strategies to attain and maintain the established standards by December 31, 1982.

The 1977 amendments to the CAA also contained provisions to obtain extensions until December 31, 1987, provided certain requirements were met. Massachusetts, which exceeds the standards for carbon monoxide and ozone, submitted its SIP to the EPA for approval in 1979 and 1982. The plan outlined strategies for achieving these standards by the 1987 extended deadline.

There are two major components to the Massachusetts SIP: a stationary source element, designed to control emissions of volatile organic compounds (VOC) emitted by previously unregulated sources; and a transportation element, designed to control carbon monoxide and hydrocarbon (a VOC and precursor to ground-level ozone) emissions from motor vehicles. Automobiles accounted for about 75% of the carbon monoxide and 60% of the hydrocarbons emitted into the atmosphere. Contained within the transportation element of the SIP is the Vehicle Inspection and Maintenance (I/M) Program. The program was designed to determine the amount of carbon monoxide and hydrocarbon emissions from the tailpipe of a vehicle and to ensure that those emissions are below the allowable limits for the various model years established by the Department of Environmental Protection (Department), formerly the Department of Environmental Quality Engineering.

The I/M program's primary objective is to reduce carbon monoxide and hydrocarbon emissions from gasoline-powered light duty vehicles. To ensure that emissions testing is accurate and fair, a fully automatic analyzer is used, with the intent of removing the subjectivity from pass-fail determinations. The analyzers also collect and store data on each emissions test

automatically,information which assists the Department and the Registry of Motor Vehicles (Registry) in monitoring and administering the Program.

On April 1, 1983 the I/M program, jointly administered by the Department and the Registry, was initiated in Massachusetts. The program replaced the former semi-annual safety inspection with an annual inspection which incorporates the traditional safety inspection of systems such as brakes and lights, and adds a tailpipe emissions test for emissions levels of carbon monoxide and hydrocarbons. Carbon dioxide (CO_2) levels and engine revolutions per minute (RPM) are also checked to determine whether there are any exhaust leaks, and to ensure that the vehicle is properly at idle. These features are also helpful in providing engine diagnostic capabilities to service stations, an added feature which enhances their ability to tune up gasoline powered vehicles.

2. CONTEXT OF CHANGES FROM NEW CLEAN AIR ACT AMENDMENTS (CAAA)

The new CAAA of November 15,1990 requires states designated as "serious" non-attainment for ozone or carbon monoxide to demonstrate air pollution reductions of at least 3% per year, beginning six years after the date of enactment, in addition to the 15% reduction from baseline emissions. Within two years of enactment, states designated as serious must submit SIP revisions to provide for an enhanced I/M program to reduce HC, CO, and NO_x emissions. Enhanced I/M programs will be comprehensively described in Final Guidance to be published by EPA, as required by the Act. The Guidance will present a performance standard with which all states will be required to comply. It will comprise emissions testing, including on-road emissions testing; a tampering and functional inspection of emission control equipment; a misfueling inspection; denial of waivers for warranted vehicles or repairs related to tampering; a $450 cost waiver expenditure requirement for emission-related repairs not covered by warranty; enforcement through vehicle registration denial; centralized testing unless the state can demonstrate a decentralized program is equally effective; a functional inspection of the emission control diagnostic system (on-board diagnostic, or OBD, systems); fuel tank pressure testing; and cannister purge testing.

It is important to note that before a vehicle is introduced to the marketplace, it must first be certified by EPA using the Federal Test Procedure (FTP). The FTP is used to certify compliance with federal new car tailpipe emission standards. This test evaluates the control effectiveness of vehicle emissions by replicating various idle and loaded mode conditions. The FTP employs the use of a chassis dynamometer and is time consuming and expensive. The current I/M inspection in Massachusetts is an

approved shortened version of the FTP and is designed to provide a convenient method of identifying vehicles that are gross emitters.

While the "short test" was adequate in the past to identify gross emitters, changes in new car technology have, according to EPA, "undermined the ability of current short tests to identify a vehicle's excess emissions." Older vehicles which do not have computer-controlled emissions systems, operated along a continuum, in that the air-fuel mixture remained at a somewhat constant ratio across much of the vehicles's operating range (idle, acceleration, and deceleration). As a result, the idle "short test" could serve as a reasonably successful surrogate of the FTP. With the newer computer-controlled vehicles, these functions are automatically monitored and adjusted throughout the operating range by the computer contained in the vehicle itself. Any short emissions test designed to assess a vehicle's emissions at idle speed will, therefore, only be capable of characterizing emissions in the idle mode. Determining emission characteristics throughout the other operating modes is not possible with the sort of analytical equipment currently in use in Massachusetts.

The newer vehicles will continue to become an increasing proportion of the Commonwealth's fleet. And that portion of excessive emissions from computer-controlled vehicles which would not be detected with the current idle mode test needs to be examined closely. As the fleet turns over to a cleaner, new technology vehicle, the current emissions test may become obsolete within 10 years and, more importantly, the control of an ever-growing fleet of new technology vehicles will far out-pace our ability to identify and control vehicles which are gross emitters. This will become an even more important factor when the Department begins to implement new legislative authority to adopt California's new-car emissions standards in their low emitting vehicles (LEV) program.

While the options to correct these problems are greater than at any time in the past, so is the realization that the automobile's contribution to the larger air pollution problem. Furthermore, failure to act to control emissions from automobiles equal to its impact will only require more stringent measures in industrial and other sectors.

3. CONTENTS AND STRUCTURE OF ANNUAL REPORT

This Annual Report differs somewhat from its predecessors in that it describes several program modifications implemented during the 1990 program (calendar) year. The Annual Report also provides statistical and other information regarding the I/M program for the 1990 program year. Reporting and evaluating this information is a necessary component of program effectiveness and quality assurance. The data provided include: general statistics

on emissions inspections performed during the program year, including a breakdown of vehicles by cutpoint category; failures of the initial emissions inspection, including a breakdown of the types of emissions-related failures, and; "retest passes," which describe those vehicles which failed the initial inspection, received maintenance, and passed a subsequent emissions retest. Other pertinent program information presented includes Registry compliance and enforcement activities, as well as a general status report on operations activities within the Department during the program year.

One major purpose for the production of this Annual Report is to present an I/M program status to the U.S. Environmental Protection Agency (EPA). As such, the data contained herein meet the reporting requirements established by the EPA.

Given the nature and magnitude of the information generated by the operation of the program, assuring the quality of that information is a critical element throughout all aspects of the program. In this context, quality assurance refers to the broad spectrum of program activities which are performed by a number of different participants in the Massachusetts automobile inspection and maintenance program to ensure that it satisfies and meets established statutory and regulatory requirements. One requirement is to ensure that consumers receive a fair and reliable vehicle emissions test. Another requirement is for a program design and equipment specification that demonstrates effectiveness in achieving air quality improvements.

Quality assurance in a narrow, technical sense, and as it relates to the emission analyzer, is divided into "internal quality control" and "external quality assurance." Internal quality control refers to those functions performed automatically by the analyzer and activities performed by analyzer operators and service personnel who maintain I/M analyzers in good working order. These activities would include: daily electrical calibration and weekly leak checks, weekly gas calibration by the operator/certified inspector, and monthly preventive maintenance by the I/M analyzer manufacturer's service representative. External quality assurance are those activities performed by personnel outside routine inspection operations who can provide accurate and unbiased assessments of the accuracy of the analyzers and the effectiveness of the program. These activities would include analyzer performance audits, data analysis, and compliance with standard operating procedures, and are the responsibility of the Department and the Registry.

In the broader view of program quality assurance the Department will examine and use program-generated data in this Annual Report to evaluate quantitatively and qualitatively the effectiveness of the program in achieving its objectives. Areas that demonstrate repeated and substantial problems as a result of

its evaluation, particularly if inattention would jeopardize the program objectives, may warrant consideration of alternative approaches to address these problem areas. The Annual Report, accordingly, serves to critically evaluate the findings generated from the analyzer audit program, inspection data, service reports from the analyzer suppliers, and any other contractual and regulatory compliance and enforcement information generated from the program.

The remainder of this section delineates how the Annual Report is structured. First, the I/M program's functions and functional relationships among the participants of the program are presented. It outlines what data are required for submittal to the Department by the manufacturers and how those data are collected and transmitted to the Department. Also, activities involving data tracking, analysis, and reporting are described. How quality control and preventive maintenance is complied with, relative to the technical and performance requirements, is also discussed. The oversight responsibilities of the Department and the Registry are described as they relate to the audit program and compliance and enforcement. The emissions analyzer currently in use in the Massachusetts program, as well as the roles played by the equipment manufacturer and the emissions inspector in the effectiveness of the program, is explained.

Second, the operations and operational interactions that occur throughout the I/M program are described. Here, the sources of data, data acquisition, data processing, data capture, and the uses of data are discussed, as is a summary of program data. Also, presented is the public outreach and public information work conducted over the year.

The Annual Report's final substantive section describes a number of things, including a description of the steps to follow during analyzer performance audits and reaudits by the Commonwealth (either the Department or the Registry), the procedures manufacturer service representatives must follow if an analyzer fails an audit, and the reporting and documentation requirements at each point in the process. In addition, there is a description of a number of changes made to the program to improve its efficiency and effectiveness.

II. I/M PROGRAM FUNCTIONS

1. INTRODUCTION

A key feature of the I/M program is quality assurance which serves as an oversight function designed to help manage and critically evaluate various and disparate program elements. It is essential that such an evaluation be a central feature of the whole I/M program to assure and improve program effectiveness, examining how those elements operate and feedback into the program. The I/M program's statutory mandate and regulatory authority contain a series of program performance and effectiveness goals that are both explicitly and implicitly expressed. Successful program performance is measured by providing, among other things, emissions inspections to the consumer that are fair, a mechanism to assure that the emission analyzers used in emissions inspections are properly used and maintained, and a process to examine the soundness of the inspection and repair process and the analyzers themselves. Program effectiveness, on the other hand, is determined by the ability of these program elements to function in a manner which achieves the program's overall goals.

This section describes the I/M Program's overall framework by identifying the functional components and illustrate how they interact. On paper, the linkages between and among each of the program elements may appear tenuous, but the program as a whole works in an effective combination, considering the fact that the Department and the Registry are agencies with different missions, program emphases, and resource allocations. These unique differences are also necessary to conduct a workable and effective program.

Figure II-1 illustrates the interactions of each of the parties involved in the I/M Program from a functional perspective. These functional interactions are defined in or governed by a complex mix of documents. While Figure II-1 gives form to the program as a whole, still it is not a complete picture. What needs to be described is where and when each functional component interacts, as well as how that dynamic operates.

Figure II-2 describes the operational interactions which transpire between and among the primary entities involved in the I/M program. This schematic elucidates several program dynamics. First, the Department functions as the primary recipient of data; second, the service stations are the primary focus of the major program activities, except for data processing; third, most interactions with the Registry are based on enforcement action; and fourth, there is marginal primary contact between the Department and the service stations, such that all major

Figure II-1
I/M Program Functional Interactions

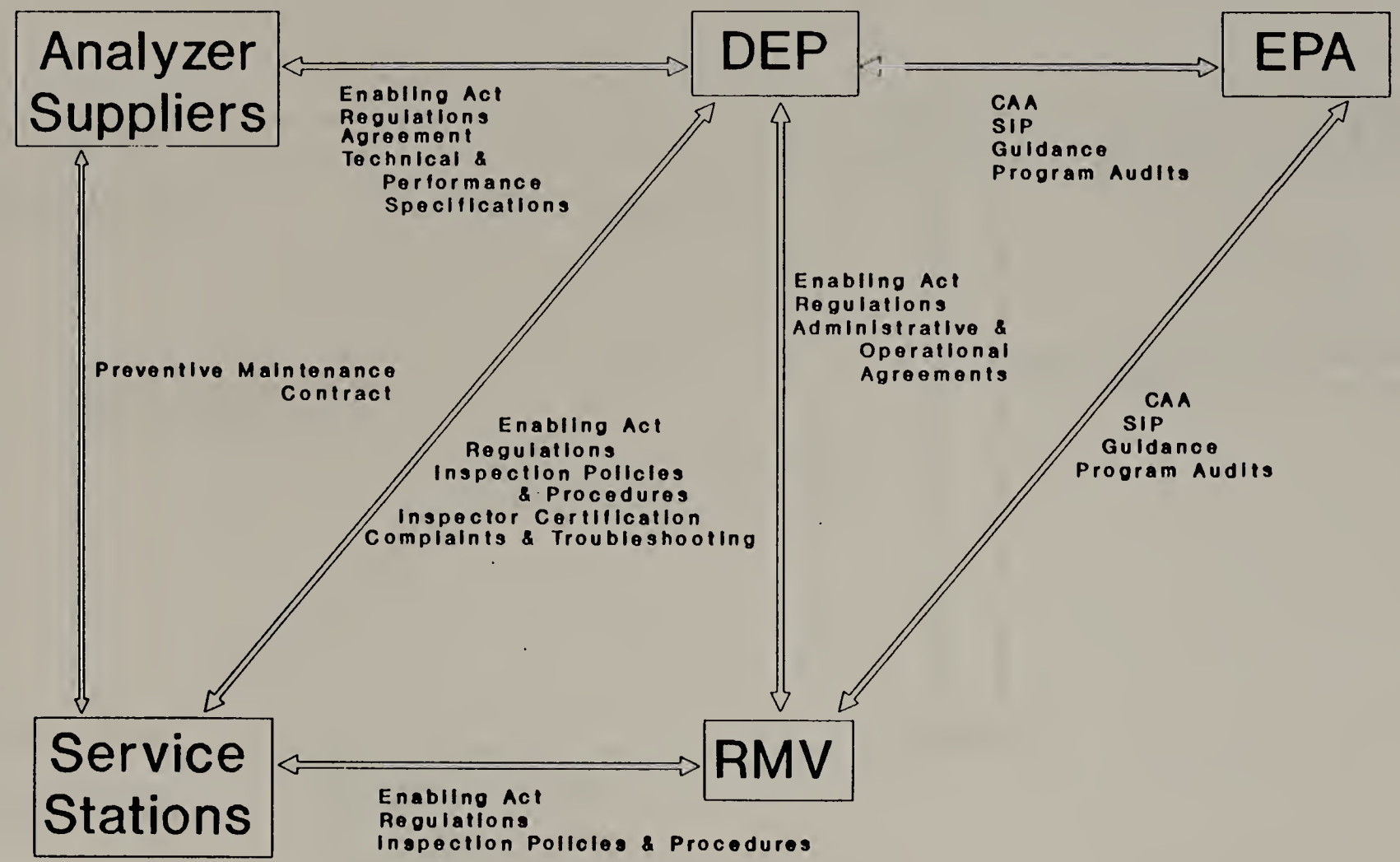
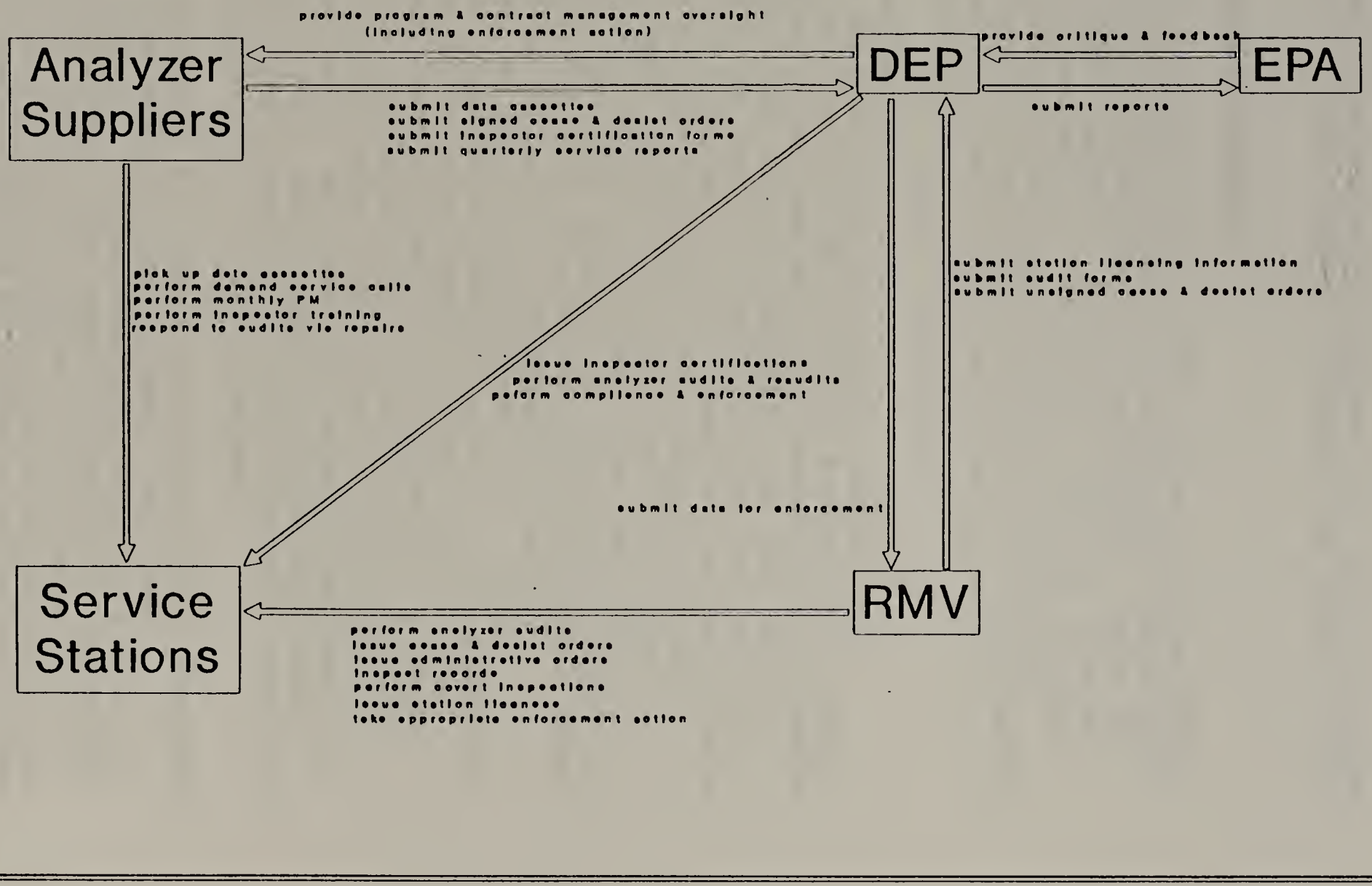


Figure II-2
I/M Program Operational Interactions



transactions occur through a third party (either the Registry or the suppliers). A more comprehensive review of operations will be discussed later in this Report.

The interactions illustrated in Figures II-1 and II-2 places into clearer perspective, the complex linkages that exist in the I/M Program.

2. DATA COLLECTION AND ANALYSIS

The I/M program is essentially a data driven program. This sub-section briefly describes the general oversight, functional issues related to the data generated in the program. Later in this Report, on the other hand, is discussed I/M data from a technical operational perspective, including assuring accuracy and completeness with regard to data collection, submittal, handling, and reporting, as well as a description of the specific data requirements for analyzer preventive maintenance and analyzer performance audits.

Data are generated from virtually all activities associated with the program, such as vehicle inspections, supplier preventive maintenance (PM) visits, and analyzer audits and reaudits. Databases are created by the Department to handle the data from the suppliers and the Registry, as well as the information received from inspector certification and station licensing. While much of the data can be used in raw form, there are also sub-systems of the databases which require further examination and refinement prior to being used for analysis purposes. In other words, after collection, the data must be examined and assessed for completeness and usefulness, based on a series of established criteria. The Department established these criteria and procedures as part of its database quality assurance. This aspect of quality assurance (i.e., data completeness and data usefulness checks) serves to (1) identify areas of potential problems with regard to data collection, processing, management, and analysis; (2) distinguish between routine data collection problems (e.g., timely collection of data) and problems with the data that may have a substantive impact on the program (e.g., data capture issues, misclassified information); and (3) ensure the integrity of the data, thus providing for critical input which will feed back into evaluating and improving the program and its effectiveness.

The following describes the major data-generating components of the I/M program from a functional perspective. These components include inspection data, analyzer supplier servicing data, and analyzer audit data; the uses of those data; potential problems with the data; and general types of QA necessary for ensuring integrity of the data. Finally, a discussion of how the data are used in evaluating program performance and effectiveness is presented.

(a) Inspection Data

Data on each inspection are recorded on mini cassette, collected and formatted by each supplier, and submitted to the Department on a 9-track tape for a calendar month 45 days after the close of the month. Such data are then incorporated into the Department's I/M inspection data file. Approximately 3.5 million emissions inspection records can be expected annually. The data in raw form can provide a number of things. First, general statistics can be generated, describing the number of inspections performed by analyzer manufacturer on a monthly basis, the number of stickers issued, the number and type of total failures, and the number of emissions challenges. Second, it can provide trends relative to, among other things, excessive passes and failures, which in turn can help target enforcement activities. Third, the data can be used to provide emissions reductions estimates, based on the number of failures/retests. Collecting and analyzing these data is necessary in order to determine program effectiveness. Therefore, maintaining an accurate accounting of the fate of failed vehicles is essential.

There are also pieces of the inspection database which require specific follow-up activity in order to more accurately characterize and analyze the data for evaluating program effectiveness. These activities (QA checks) help to distinguish which data problems are procedural from those that may be substantive. Non-reporting stations are a good example of how these QA checks are needed to ensure data integrity. The non-reporting stations "category" includes stations with a number of unique features. Some stations have closed for prolonged vacations, renovations, or loss of license. Other stations no longer perform inspections, have not paid their monthly Preventive Maintenance (PM) contract payment to the supplier, or have changed the type of analyzer used at their inspection stations. Stations which are temporarily or permanently not inspecting vehicles are important to note and through the Department's data analyses will be deleted from the database. However, the other listed conditions, such as stations which have not made their PM payment, are important for other reasons and must be handled differently. These cases address compliance and enforcement matters, and more specifically, the proper use and maintenance of the inspection analyzers themselves, and the compliance status of the supplier with the specifications and Agreement.

Suppliers are required to perform routine monthly PM on the analyzer. During the PM checks the cassette tape containing the recorded data of all inspection transactions which have occurred since the previous visit, is replaced with a blank tape. The PM visit only occurs if the station has satisfied its contractual obligations. If not, the supplier can legally refuse to perform

the PM check. In such cases, the cassette tape is not collected and the summary data on inspections flags the station as "non-reporting". A provision of the Agreement between the Department and the supplier, in fact, relieves the supplier of his obligation to supply such information to the Department in the event that an inspection station is not meeting its contractual obligations. The long-term promise of air quality benefits from the I/M program can be assured only if the equipment is routinely and properly maintained. In other words, the motorists cannot be assured of a fair test unless the inspection equipment is used properly and that the analyzer itself continues to meet Department established technical and performance specifications.

There are a number of important problems that arise from this situation. One has to do with data capture. The emission analyzers, in most cases, automatically stop performing additional inspections if the data tape cassette is full. Prior to changes ordered by the Department and made by the equipment supplier in early 1991, several analyzers were not capable of locking out when the data cassette became full.

An issue related to the capacity of the tapes themselves may contribute to what has been construed and misclassified as data loss. Each supplier's tapes has the capacity to store inspection data as follows: Environmental Systems Products (ESP, formerly Hamilton Test Systems) - 350 inspections; Bear - 850 inspections; Sun - 500 inspections; and Allen - 600 inspections. If a PM check is not performed based, for example, on the station's non-payment of contract, the supplier may elect to not collect the cassette tape. The data submittal to the Department, therefore, may not be made within the required timeframe. Data unable to be reported as a result of this scenario may more accurately be referred to as delayed data, <u>not</u> data loss. While the data may not be submitted to the Department in the prescribed timeframes, it is reasonable to assume that those data will be submitted once the supplier and the inspection station resolve their differences. Of course, the Department will continue to monitor submittals for such parameters and take appropriate action. From a compliance and enforcement perspective, receiving inspection data in a timely manner is important, but the supplier's data submittal requirement is 45 days after the close of a given month. Accordingly, the inspection data, notice of a station's status (e.g. non-reporting), or other such information, will not reach the Department for up to 75 days from the date of inspection. Compliance and enforcement strategies must acknowledge these timeframes in planning effective responses warranted by each circumstance. In fact, alternative measures may be necessary to gather and report information for effective program enforcement.

The process of recording, collecting, submitting, and analyzing the data through the current tripartite chain-of-custody (Supplier-Department-Registry) was neither designed to serve all the data, compliance, and enforcement needs of the program individually, nor to do such all at the same time. However, the data management system is capable of evaluating the program as a whole.

Two additional, but unique, aspects of the inspection procedure involves reinspection and challenge tests for vehicles that fail their initial emissions test. Currently, the statute and regulation address both reinspection and challenge tests. The statutory language is quite strictly constructed as an either/or option, and cannot be done one in lieu of the other. The regulation more specifically affords a free reinspection to a vehicle which fail the initial inspection and has had all necessary repairs performed. This group of vehicles comprises the "gross emitters" targeted in all state I/M programs. The repair and number of these vehicles that subsequently pass upon reinspection, represents a key input parameter in the computer model (currently MOBILE 4.1) developed by the EPA in order to help determine the performance of I/M programs. If the vehicle passes the reinspection a sticker is issued. If the vehicle fails again the owner is then eligible, subject to specified conditions, to receive a waiver from a Registry "Referee" station.

The second option available to the motorist whose car has failed the initial inspection is to request from the Registry an Emissions Challenge Certificate. If granted, a challenge test is performed at a licensed inspection station other than the original. A sticker is issued if the vehicle passes. If not, the process involving the Temporary Maintenance Form (TMF) is initiated. This involves more complicated factors and documentation, such as required repairs to be performed and severe problems/delays in the availability and delivery of relevant auto parts. A mechanism to track all these data with as high a data capture rate as is possible is important in order to identify critical problem areas.

(b) Analyzer Supplier Servicing Data

The analyzer supplier servicing data is a Department-required data submittal item for a host of reasons. In its most general sense these data provide the Department with one of many program management tools. Accordingly, these data can serve as an early warning system on the overall health of the analyzers in the field. The Department will respond to problems as necessary. On a quarterly basis, analyzer suppliers are required to submit a report documenting all scheduled monthly PM checks and unscheduled demand maintenance calls. Such documentation must include the following: the dates and nature of

each visit/response; a record of station locations and names of station employees who have recently been trained to operate the analyzer; notice and location of installation of each analyzer; immediate notification of any generic design or functional defects; notice of any cancellation of a service agreement by the supplier resulting from a failure or interruption of payment of the service agreement by an inspection station, or for any other reason. Implicit in the above is the added responsibility on the part of the supplier to respond when an analyzer fails a performance audit and receives a Cease and Desist Order. Analyzers shut down by an auditor from the Registry or the Department are precluded from use in performing emissions inspections. Because inspection station owners will want their analyzers operational as soon as possible, the response by the supplier is akin to a demand service call. To complete the audit cycle the supplier must repair and specifically note each analyzer component repaired on the signed Cease and Desist Order in order to return the analyzer to full service. They are also required to submit all associated documentation to the Department.

The Department oversees and manages the information submitted by the suppliers. Failure to comply with the specifications, regulations, agreement, or any other relevant document would warrant a response by the Department appropriate to the nature and degree of non-compliance and sufficient to correct the deficiency.

(c) Analyzer Audit Data

Analyzer audit data are generated at various points throughout a completed audit cycle and are discussed to varying degrees of detail, perspective, and emphasis in sections III-2 and III-5. In general, however, the Registry performs the initial analyzer audit on each emissions analyzer twice per year, completes the audit form, and mails a copy to the Department. A failure of the analyzer during the gas audit generates an Order by the Commonwealth to cease and desist further inspections until the analyzer is repaired and returned to service by an authorized technician employed by the equipment supplier. As in the case of the Initial Audit Form, a copy of the Cease and Desist Order is also sent to the Department. Upon receipt of these forms, the data are entered into a data system at the Department. Once the Cease and Desist Order has been issued, the equipment supplier is contacted by the inspection station. The supplier's service technician repairs the analyzer accordingly and completes the portion of the Cease and Desist Order form noting the specific item(s) repaired. The supplier signs and mails to the Department a second copy of the Cease and Desist Order, which supplements the data file on this particular analyzer. These data are then summarized and analyzed in periodic reports, which may indicate

any trends that may have occurred over time and may suggest possible programmatic or administrative solutions. One such summary, for the 1990 program year can be found in section III-5.

3. COMPLIANCE AND ENFORCEMENT

Analyses of the inspection data and the supplier's service reports are the primary means by which compliance status is determined and reported by the Department. The inspection data focuses on compliance with procedural requirements by inspection stations, while the service reports provide insight on the performance of the suppliers. Such analyses can help direct and refine priority compliance and enforcement strategies, at the Registry or the Department. Additional activities used to augment and better target compliance and enforcement, which in turn generates additional data for analysis, include examining the data from analyzer audits, covert inspections, administrative audits at licensed inspection stations, and surveys of vehicles for valid certificates of inspection. Collectively all these disparate program components make up the key elements of program compliance and enforcement, and each component collects unique types of information for analysis, as described below in their functional context. Since 1983, most of the data management and contract compliance has been the responsibility of the Department, while the primary vehicle and station enforcement authority has been vested in the Registry.

The Registry of Motor Vehicles utilizes four state vehicles for covert inspections and other compliance activities. Two of these vehicles have been tampered with purposefully (with EPA's approval) and are used to monitor the completeness and overall performance of the emissions inspection. The Inspectors' (RMV Auditor) personal vehicles are also used for covert inspections. All covert inspections are based on probable cause using documentation such as Department enforcement reports, motorist complaints, excessive Certificate of Inspection sales, and Inspectors' documented observations. A typical, straightforward covert inspection might involve an undercover state Inspector submitting for inspection an unmarked vehicle. The vehicle will display a current Certificate due to expire in the month of submission. The inspection fee is paid and the entire inspection process is closely monitored. Violations are recorded and immediately issued to a person of supervisory responsibility at the licensed inspection station.

All violations are reviewed at the Registry's I/M central office in Boston for disposition. A final determination is based on the severity of the violation(s) and past record. Any suspension of the station license is in accord with the applicable Registry of Motor Vehicles regulation 540 CMR 7.08 as summarized in Table II-1 below. Final enforcement actions taken

SUSPENSION PERIODS FOR VIOLATIONS OF INSPECTION PROCEDURE REQUIREMENTS

(Certificates of Inspection, as used herein, includes Certificates of Rejection)

Type of Offence	First Infraction	Second Infraction	Third Infraction	Subsequent Infraction
1. Failure to maintain inspection bay in proper manner, 2. Failure to maintain adequate supply of Certificates of Inspection, 3. Failure to maintain adequate security of Certificates of Inspection, 4. Failure to properly keep required records or properly complete required entries on Certificates of Inspection, 5. Failure to charge the established inspection fee, 6. Failure to comply with any provisions of 540 CMR 4.00 or the Registrar's written policies or procedures relating thereto not otherwise specified herein.	Warning Up To 30 Days	Up To 30 Days	Up To 60 Days	Up To 90 Days
1. Failure to apply Certificate of Inspection to vehicle as required, 2. Issuing Certificates of Inspection without performing a complete inspection, 3. Failure to perform complete inspection in designated inspection bay, 4. Failure to have on hand required equipment in proper working condition.	Up To 30 Days	Up To 60 Days	Up To 90 Days	Up To 1 Year
1. Suggesting or requiring that unnecessary repairs or adjustments be made in order for vehicle to pass inspection, 2. Deliberate falsification or alteration of recorded data pertaining to inspection, 3. Licensee or employee performing inspections while under the influence of liquor or drugs.	Up To 90 Days	Up To 180 Days	Up To 270 Days	Revoke

REGULATORY AUTHORITY

540 CMR 4.01: M.G.L. c.90, s.31
M.G.L. c.90, s.7A
M.G.L. c.90, s.7V(a)(b)(c)
M.G.L. c.90, s.7W

which may impact the station's licensing status will be forwarded to the Department for appropriate entries or deletions in the station file.

Inspection station administrative audits are also conducted on a rotating schedule. Administrative audits are conducted according to the provisions of 540 CMR 4.08. In general it includes: checking for adequate numbers of Certificates of inspection and rejection and that adequate security exists concerning these certificates; ascertaining that the numbered Class License poster is conspicuously displayed and likewise the emissions cutpoint standards poster and the hours of inspection; checking the availability and substance of facility records pertaining to inspections (e.g. analyzer printouts); and checking the inspection facility for conformance with established equipment and station requirements. All field inspectors maintain a log book arranged by individual stations. During each routine visit, the inspectors are required to carefully review the inspection station copies of the analyzer printouts for accountability and integrity of recorded data. Inspectors also review the corresponding tapes for the sequential series of Certificates being sold.

All irregularities observed or found by the State Inspector relative to inspections, audits, or paperwork are recorded in the station log book with a compliance response appropriate to the infraction. Unscheduled visits also require a complete station review with commensurate log entries. Any problems arising from an administrative audit which results in a final enforcement action affecting the status of the station, the analyzer, or certified inspector will be forwarded to the Department.

Sticker surveys are conducted monthly across the Commonwealth and are also important to assure motorist compliance with the inspection regulations. Each of the five RMV geographic regions are required to submit a completed Certificate of Inspection Survey form (see Illustration II-1) listing the results from several different locations off the public road, i.e., public or private parking lots, shopping malls, school parking lots, etc. Vehicles not displaying the required Certificate of Inspection are issued a Registry of Motor Vehicles Courtesy Reminder card (see Illustration II-2). Typically, the data indicate a noncompliance rate of less than 3%.

The data generated from the activities described in this Annual Report are used to direct enforcement assignments, gauge the effectiveness of compliance and enforcement regulations, and supplement the I/M database on relevant issues, as appropriate.

In sections III-4 and III-5, an examination is made relative to the pass and failure rates during inspection and reinspection; and the compliance data generated from the analyzer audits,

ILLUSTRATION II-1

CERTIFICATE OF INSPECTION SURVEY INSP._____

1. DATE_____ LOCATION_____

VEHICLES CHECKED_____ STICKER VIOLATIONS_____

REG.#_____ _____ _____ _____

_____ _____ _____ _____

2. DATE_____ LOCATION_____

VEHICLES CHECKED_____ STICKER VIOLATIONS_____

REG.#_____ _____ _____ _____

_____ _____ _____ _____

3. DATE_____ LOCATION_____

VEHICLES CHECKED_____ STICKER VIOLATIONS_____

REG.#_____ _____ _____ _____

_____ _____ _____ _____

4. DATE_____ LOCATION_____

VEHICLES CHECKED_____ STICKER VIOLATIONS_____

REG.#_____ _____ _____ _____

_____ _____ _____ _____

5. DATE_____ LOCATION_____

VEHICLES CHECKED_____ STICKER VIOLATIONS_____

REG.#_____ _____ _____ _____

_____ _____ _____ _____

ILLUSTRATION II-2

REGISTRY OF MOTOR VEHICLES

COURTESY REMINDER

REGISTRATION NUMBER _____

Place Stamp Here

The inspection sticker attached to this vehicle has expired.

All inspection stickers expire 1 year from month of issue (as indicated by large number in center of sticker) or upon transfer of ownership.

All motor vehicles must be inspected within 7 days after initial registration in Massachusetts.

The last number on the license plate and date of inspection do not have to correspond. Early inspection is permitted for convenience or to prevent expiration during out-of-state travel.

After this vehicle is inspected, please fill in the new sticker number _____ _____, the date of inspection _____ and mail this card, as provided on the other side.

The penalty for inspection violation conviction is $50.00.

REGISTRY OF MOTOR VEHICLES
VEHICLE INSPECTION SERVICES
100 NASHUA STREET
BOSTON, MA 02114

covert inspections, inspection station administrative audits, and sticker surveys. Also, the most likely cause(s) of any particular problems are identified and discussed. These analyses, accordingly, serve as the raw material for determining, in part, overall program performance and effectiveness.

4. COMPUTERIZED EMISSION ANALYZER

This section describes the measures taken to assure program quality through use of state-of-the-art analytical equipment, as well as emission analyzer preventive maintenance and quality control. This involves a complex assortment of automatic features built into the analyzer itself and requirements made of analyzer manufacturers relative to consistent and routine preventive maintenance, recordkeeping, and data reporting. Explicit in the manufacture's role is training inspectors on relevant operating and maintenance procedures. This assessment is also consistent with the most current EPA guidance on quality control for I/M programs (EPA 460/3-82-00), the following addresses the essential program components.

From the outset of program development, the Department decided to design an exhaust emissions analyzer that was essentially fully-automated. The decentralized program structure warranted a unit that was durable, versatile, and tamper-resistant within technical and economic limits. An analyzer of such specification could achieve those goals and provide reasonable assurance that the integrity of each inspection could be maintained. More specific to the goal of I/M programs, a computerized analyzer could improve appreciably program effectiveness in terms of air quality benefits and provide a consistently strong foundation for enforcing the warranty protection provisions of the Clean Air Act.

The Department, therefore, wrote technical and performance specifications based on BAR-80 (California Bureau of Auto Repair, 1980 Specifications) analyzer specifications and some additional features suggested and approved by the EPA.

In determining the technical specifications an emissions analyzer must meet in order to be used in the Massachusetts I/M program, the Department was concerned with (a) consistency in the test procedures and in test results among all stations and at each individual station over time, (b) accuracy and reliability, (c) capability for storage and collection of data, (d) provision for proper maintenance, and (e) detection of analyzer failures or tampering. The technical specifications adopted ensure that the analyzers used in Massachusetts address these concerns. Inconsistencies for example in calibration, test results, and/or data reporting would undermine public confidence in the fairness

of the program and would make it impossible to evaluate whether or not the I/M program was achieving its emission reduction and air quality improvement objectives.

The technical specifications require a three-gas exhaust emissions analyzer equipped with a micro-processor computer. In addition to measuring levels of carbon monoxide and hydrocarbons, the analyzer must check CO_2 levels. Measurement of CO_2 levels during the test ensures that the gas sampling is not being diluted by leaks in the sample hose and validates that the probe is fully inserted in the tailpipe. The validity of the test is also ensured by two additional lock-out devices required in the specification. The operating temperature lock-out prevents operation in test mode until proper machine warm-up has occurred. A tachometer measuring engine speed causes an error message to be displayed if the idle speed exceeds certain levels.

The micro-processor's automatic functions are designed to ensure that different tests at different stations are equivalent. The same is expected of tests performed at the same station over time. The computer itself makes the automatic pass/fail decision, based on the cutpoints stored in its memory. An automatic prompting sequence guides the inspector through the test steps, thus ensuring that all tests follow an identical procedure. The machine calibrates itself and has several automatic features designed to test its own functioning and to cause error messages in the event of any system failure. These automatic features include weekly automatic gas spanning, automatic checks for leakages, low flow indicators, automatic HC hang-up checks, and automatic test averaging and sequencing.

The analyzer provides a printout of the test results for the motorist. With automatic data recording and storage, the Department is able to monitor the various program functions and to verify that emissions reductions, and therefore air quality improvements, are being obtained.

5. MANUFACTURER PREVENTIVE MAINTENANCE

Each manufacturer of approved emissions analyzers must enter into a Preventive Maintenance (PM) Contract with a licensed inspection station. Manufacturers must provide proficiency training on their analyzer, prompt and effective repair of inoperable units, and monthly preventive maintenance on each analyzer. These requirements were established under statutory authority, the technical and performance specifications, regulations, and other such documentation.

Specific procedural requirements have been established and are conducted monthly by service technicians. These procedures are conducted in the following sequence: (a) warm-up analyzer for at least 15 minutes; (b) clean analyzer: exterior, interior,

exhaust fan filters, and sample probe and hose with compressed air; (c) change cassette tape; QC replacement tape to assure tape and printer are operational; (d) perform zero and gas calibration for HC, CO, and CO_2; (e) check consumable item inventory (print paper and ribbons); (f) perform leak check; (g) clean filters, replace, as necessary; (h) replace sample hose, as necessary; (i) test RPM simulator; (j) check calibration gas pressure, replace, as necessary; (k) perform simulation inspection to test whole system; and (l) wipe down analyzer with appropriate cleaner.

Each manufacturer may modify the order or content of each procedural element. Also as stated earlier, record-keeping is performed automatically, the results of which are transmitted to

the Department for tracking manufacturer maintenance activities, as well as for vehicle inspections.

6. EMISSION INSPECTOR'S ROLE IN QUALITY CONTROL AND PREVENTIVE MAINTENANCE

The option exists for licensed inspection stations to lease approved I/M emissions analyzers, but nearly all inspection stations have purchased their units. While the manufacturer is required to supply and perform appropriate maintenance on the analyzers, the licensed inspection station owner is responsible for the day-to-day upkeep of his unit.

Procedural instructions have also been given to the inspection stations relative to the proper routine activities to maintain the analyzer's ability to function. They are: (a) keep exhaust hose and probe clean and dry by applying compressed air to this system, on a weekly basis; (b) check sample system filters, and clean and replace, as necessary; (c) keep air filter clean by washing screen with soap and water, and blowing dry with compressed air on a weekly basis; and (d) change printer paper, as needed.

7. PROGRAM PERFORMANCE AND EFFECTIVENESS

The primary factors which determine the emissions reductions of an I/M Program are the number of initial inspection failures minus those vehicles that pass upon reinspection. These vehicles are essentially the "gross emitters" targeted in the I/M Program which are subsequently repaired to meet the appropriate emissions cutpoint. However, this is only one part of what makes an effective and truly successful I/M Program.

At a minimum, program information is generated to provide a useful tool for program management relative to program status and direction. Individual components of those reports provide guidance relative to the status of inspections, supplier compliance, and Registry compliance and enforcement activities.

Because there are so many various and disparate programmatic elements, this Annual Report seeks to first identify and describe each separately, then to demonstrate how each individual part interacts within the whole program.

In any program of this dimension there are clear, and not so clear, programmatic directives required by and emanating from, a spectrum of sources. There are three governmental agencies (one federal, two state)that are to varying degrees responsible for implementing and managing the I/M Program. Each has its own substantive and historical statutory and regulatory context. Each has its own set of programmatic priorities. And each has limits to its own overall capacities and capabilities in terms of personnel, equipment, and other resources. Constraints in any one area will affect the successful achievement of established objectives.

In addition, the emissions analyzer technical and performance specifications and the agreement between the Commonwealth and analyzer suppliers all help to focus and better monitor and manage supplier compliance with program requirements.

The overall picture, therefore, of true program effectiveness must appreciate, acknowledge, and integrate the disparate statutory and regulatory authorities, the technical and performance requirements, the contracts that exist between and among the affected parties, and the various policy and procedural determinations which in toto serve as the foundation for this formidable regulatory program. Accordingly, this explains the complex structure of the current I/M program and what inherent barriers may, at times, stand in the way of achieving what may otherwise appear to be an easily attainable program goal. It is therefore incumbent upon program analysts and observers to view the program in its ability to achieve its air quality and other program objectives with a view broad enough to encompass the I/M program in all its diversity.

III. I/M PROGRAM OPERATIONS

1. INTRODUCTION

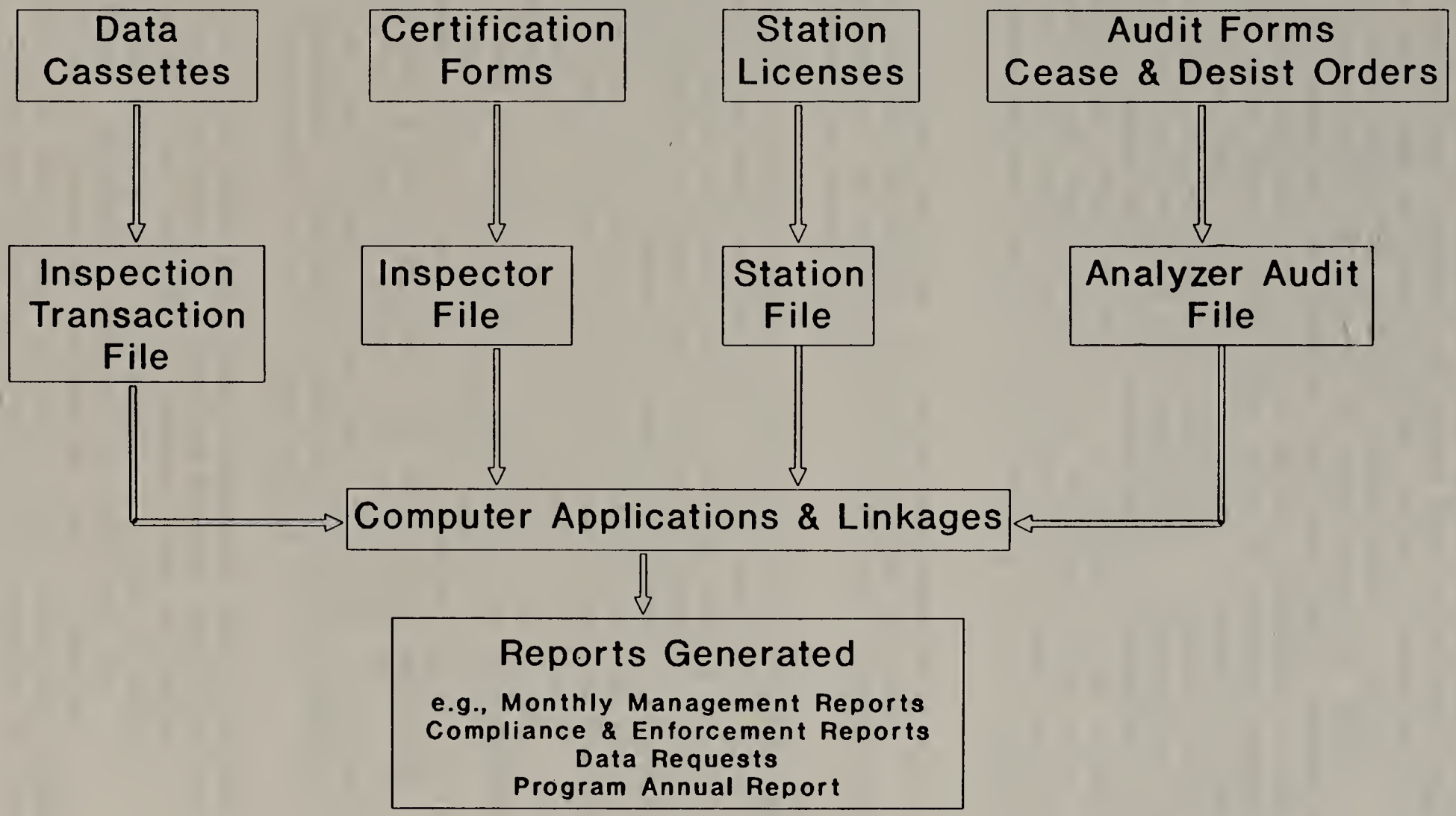
As discussed and illustrated earlier, the I/M program is a data driven program. General maintenance of the various databases housing these data entails quality assurance and quality control, while ongoing evaluation of the data includes generating reports which represents the data and analyses of those data.Both functions are necessary program components for ensuring data integrity, as well as for evaluating program effectiveness. This section describes the general sources from which the I/M data are generated, the methods by which the data are acquired and processed, and the various functions and operations which the data serve, including summaries of (1) public outreach and public information statistics, (2) inspection transaction data, and (3) analyzer audit program data for the 1990 program year.

Because the I/M program is jointly administered by the Department and the Registry, it should be re-stated that the Registry has been primarily responsible for enforcement activities at the inspection stations, on the road, and concerning motor vehicles in general. The general oversight, management, administration, and some day-to-day operations of the emissions portion of the inspection program are the responsibility of the Department. This situation requires a close working relationship between the two agencies, as information critical to fulfilling each agency's regulatory obligations is an essential ingredient to that partnership.

2. IMPORTANCE AND ROLE OF DATA IN PROGRAM OPERATIONS

Data for the I/M program are generated at the inspection stations, through various conduits, such as the certified inspectors who are employed at the stations, the approved analyzers used to perform inspections at the stations, and the state analyzer auditors who audit the analyzers at the stations. The data are collected from the inspection stations by the analyzer suppliers, the Registry, and the Department. There are currently four databases, of varying sizes, which house these data. They are: the inspection transaction file, which includes data regarding each inspection transaction; the inspector file, which contains information regarding the certification of every inspector; the station file, which holds the names and addresses of all licensed inspection station in the Commonwealth; and the analyzer audit database, which includes information based on biannual audits and reaudits of the emissions analyzers performed by the Registry and the Department, respectively. Figure III-1 depicts the various databases and their inputs, as summarized below.

Figure III-1
I/M Data Inputs & Outputs



Emissions and safety data for each vehicle inspection performed with an approved emissions analyzer at an inspection station are recorded onto a cassette tape which is housed within each analyzer. Routine collection of these data and submittal to the Department is required of the supplier under a contractual agreement between each supplier and the Department. During prescribed, routine monthly PM visits to each station, the supplier service representative removes the used data cassette from each machine and replaces it with a blank cassette. The collected cassettes are then transferred onto a 9-track master tape at the supplier's facility, which in turn is sent to the Department for further processing and analysis. Figure III-2 depicts the process of collecting the cassettes, processing them for submittal to the Department, and subsequent processing of the tapes by the Department, once in-house. A number of QA checks and queries are made, and reports are run on these data on a monthly, quarterly, and yearly basis. To perform these functions, the Department spends approximately $5100 each year in computer time alone.

Table III-1 displays the type of data recorded onto the cassettes and the format in which it is submitted to the Department for analysis. An estimated 3.5 million inspection transactions are recorded every year.

The Department has established a certification program for inspectors to conduct emissions testing. Such certification involves training by each supplier and is based upon a proficiency determination on the use of the equipment. Once trained by the supplier, an inspector must complete and submit a Massachusetts Emissions Inspector Certification Form to the Department. Upon review of the information contained on the form, the Department issues the certification directly to the inspector. The inspector file, listed in Figure III-1, was created to track these certifications. The file is structured to provide the name, address, drivers license number, and certification number of the inspector; the license number of the inspection station where the inspector is currently employed (which is linked to the station file); and the type of analyzer(s) on which the inspector has been trained. According to the inspector database, currently there are approximately 13,000 certified inspectors in the Commonwealth.

The station file provides the name, address, and license number of each inspection station licensed by the Registry to perform combined safety and emissions inspections on motor vehicles and the type of analyzer currently in use at that station. The file was initially created in 1983 by the Department to serve as a tracking mechanism for licensing inspection stations, and continues to serve both the Department and the Registry. There are approximately 4000 records in the station file. Any updated information for this database is

FIGURE III-2

DATA ACQUISITION FLOW CHART
MASSACHUSETTS I/M PROGRAM

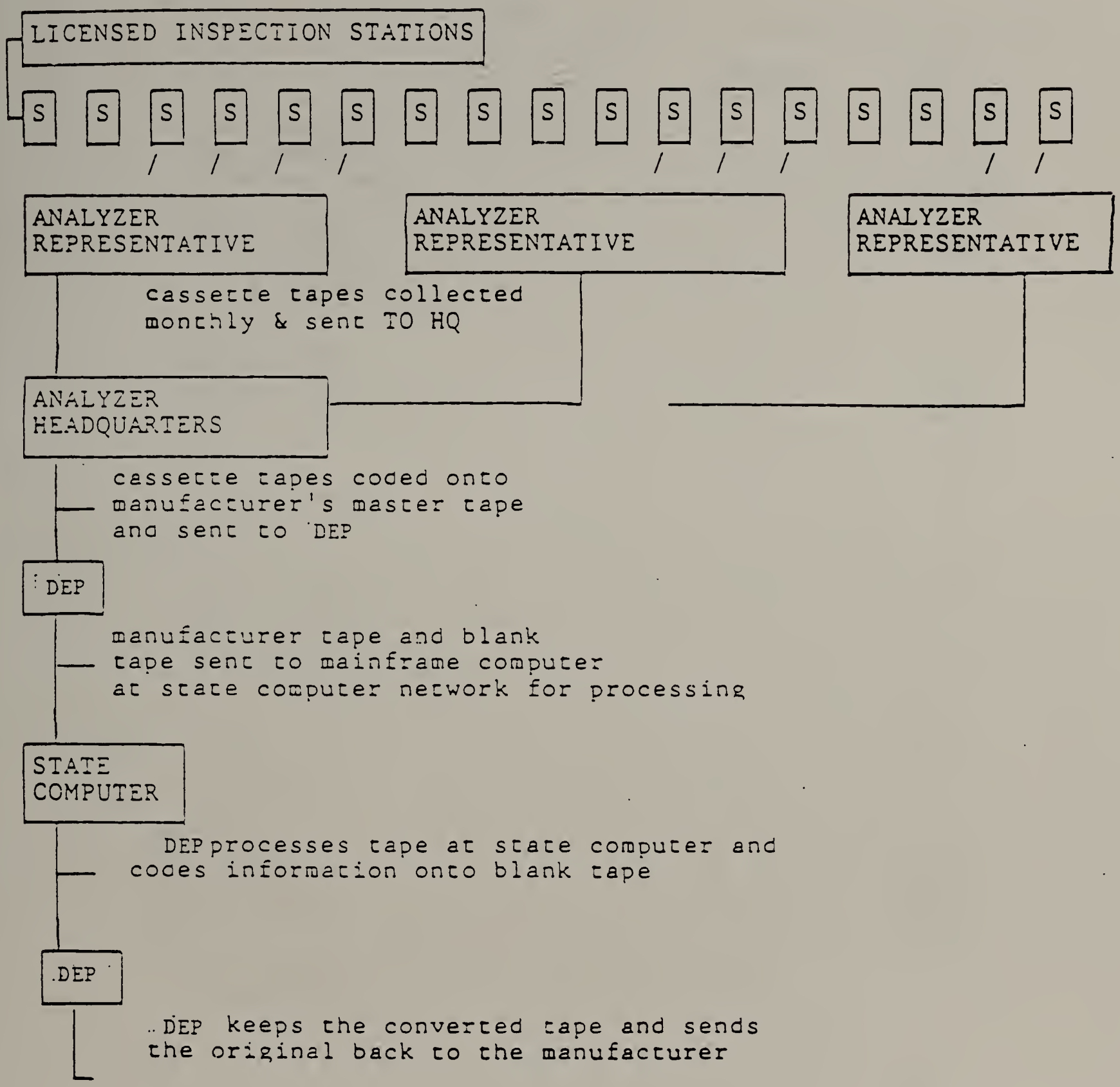


TABLE III-1

The format of the individual inspection transaction records is

Field	Length	Column
Station Number	7	1-7
Date (MMDDYY)	6	8-13
Inspector Number	5	14-18
Type of Test I for Initial R for Retest C for Challenge	1	19
Vehicle Make	5	20-24
Vehicle Year	2	25-26
Odometer (thousands)	4	27-30
Plate Number	8	31-38
Fuel Type G for Gas D for Diesel	1	39
Vehicle Type A for Passenger Auto B for Light Duty Truck C for Motorcycle D for Heavy Duty Truck E for Other/Exempt	1	40
Air Pump Y for Yes N for No	1	41
HC PPM	4	42-45
CO% X 100	4	46-49
CO2 X 100	4	50-53
Sticker Number	8	54-61
The following 16 Pass/Fail bytes are coded 0 for Pass 1 for Failure		
CO2%	1	62
CO%	1	63
HC	1	64
Fuel Filler Neck	1	65
Catalytic Converter	1	66
Other	1	67
Bumpers/Fenders	1	68
Number Plates	1	69
Window/Wipers	1	70
Horn	1	71
Steering System	1	72
Muffler/Exhaust	1	73
Turn Signals	1	74
Head/Tail Lights	1	75
Brakes	1	76
RPM	1	77

provided to the Department by the Registry either through the submittal of copies of new licenses or through forwarding of address or name changes by clerical staff.

The analyzer audit database tracks and documents analyzer performance through the audit program at every stage in the audit cycle. As mentioned previously, the audit cycle begins with information from analyzer performance audits conducted generally by the Registry. Cease and Desist Orders are then issued against an analyzer which fails an audit. Reaudits are subsequently performed by the Department on repaired analyzers. Each emissions analyzer is scheduled to be audited twice per year. This would yield an audit file of approximately 4800 records yearly (2400 analyzers x 2). The database is comprised of data compiled from completed Audit forms and Cease and Desist Order forms, and includes information, keyed on inspection station, regarding the calibration of the analyzers during the audit, reasons for audit failures, repairs made to failed analyzers, and general administrative information which helps the Department track whether forms have been appropriately completed and submitted to the Department.

The data collected for each of the I/M program databases are routinely summarized in report form and analyzed. The data reports are available to and used by several entities, including the Department, the Registry, the EPA, and occasionally the public. These reports serve a number of functions. The data reports are used by the Department to routinely monitor program quality control, compliance, and enforcement, specifically by tracking analyzer supplier contract compliance with Department specifications, contract provisions, and regulations. Program compliance is also monitored through the data by the Registry, in conjunction with the Department, to ensure inspection station compliance with applicable regulations and procedures regarding the safety and emissions test. For example, reports can be generated which list non-reporting stations and stations which appear to have excessively high pass or failure rates. In addition, other quality assurance checks may be implemented which, for example, elucidate discrepancies in the issuance of stickers.

The data are also critical for evaluating program effectiveness. Several data reports are routinely prepared by the Department which summarize data received from each analyzer manufacturer through the inspection transaction file. These reports include: monthly or yearly breakdowns of summary statistics by manufacturer on the number of inspections, initial failures and subsequent retest passes, emissions challenges, and types of failures.

Certain databases, such as the inspection transaction file, warrant monthly QA checks and reports, while others, such as the analyzer audit database, require less aggressive monitoring. All databases, however, are routinely maintained, and may be updated on a daily basis, if necessary. Findings, conclusions, and recommendations regarding steps to resolve any data problems raised during data evaluation and analysis are made as soon as possible after being identified as a problem. Some of these are described in Section IV of this report.

3. PUBLIC OUTREACH AND PUBLIC INFORMATION

(a) Phone Log/Public Inquiries

One major aspect of program operations within the Department involves public outreach and public information. In 1990, the Department received numerous telephone calls and written requests from a variety of sources which included businesses, inspection stations, the general public, and local, state, and federal agencies. The requests ranged from searches of one of the databases for specific information, to queries regarding waiver procedures, to general questions about the program. Table III-2 presents a breakdown of the types and number of telephone queries which were logged-in during 1990. Queries regarding specific program components comprised the bulk of the calls. These questions covered topics such as warranties, waivers, imports, consumer protection, engine switching, failures in RPM, catalytic converters and fuel filler necks, and special test procedures on Fords and Hondas. A significant increase in the number of calls regarding inspector certification, compared to previous years, was noted. This was a direct result of the new inspector certification procedures instituted in November, 1990, which is described in Section IV of this report.

Inquiries are initiated by these requestors for a variety of reasons. A breakdown of the calls logged-in during 1990 by requestor is presented in Table III-3. Calls from the general public comprise the bulk of the queries.

Since the I/M databases are public record, it is part of the Department's responsibility to respond to requests for access to those data. As shown in Table III-2, there were 43 telephone requests for data searches of the transaction file. These requests are routed to the Information Systems Branch, and require that individual 9-track tapes are hung at the State College and searched, based on the specified parameters. Processing these requests takes a certain amount of time, sometimes several weeks, due in part to the sheer volume of the database that must be searched and the fact that the Department competes with other state agencies for computer time. Some

TABLE III-2
Number and Types of Telephone Inquiries
Regarding the I/M Program
(January 1 - December 31, 1990)

TYPE OF INQUIRY	NO. OF CALLS
Queries Regarding a Specific Program Component*	262
Inspector Related (Certification/Transfer)	184
General Program Information	61
Records Search (ISB)**	43
Data Printout Request (APIB)***	20
Payment of Monthly Preventive Maintenance Fee	12
Coverage under Service Contract	11
Data Specific Administrative Issues	7
Service Station Complaints	6
TOTAL CALLS LOGGED IN	606

* Includes issues such as warranties, waivers, imports, consumer protection, engine switching, failures in RPM, catalytic converters and fuel filler necks, and special test procedures

** ISB = Information Systems Branch within the Div. of Air Quality

*** APIB = Area Programs Implementation Branch within the Div. of Air Quality

TABLE III-3
Breakdown of Logged In Telephone Inquiries
by Requestor
(January 1 - December 31, 1990)

REQUESTOR	NO. OF CALLS	% OF TOTAL
General Public	232	38.3
Inspection Stations	130	21.4
Agencies (Local, State, Federal)	82	13.5
Certified Inspectors	65	10.7
Analyzer Manufacturers	61	10.1
Businesses	36	6.0
TOTAL	606	100.0

requests require the generation of printouts spanning several years of data for a particular station, and others require one transaction listing for a particular station on a particular date. Both requests, however, require, at a minimum, the hanging of at least one tape, and a search through at least one full month's worth of data for one analyzer, which translates into a search through an average minimum of 86,000 records.

(b) New Posters and Failure Brochures

Because the I/M program requires the past 15 vehicle model years be subject to emissions inspections and the pass/fail cutpoints are tagged to model year groupings, the Department produces annually wall posters for licensed inspection stations to display for the public (see Appendix A). As such, the Department must layout and have printed approximately 3000 I/M posters each year.

The Department also produces about 380,000 Failure Brochures (see Appendix B). This Brochure is distributed at the inspection stations at the time of an inspection failure. By regulation, Failure Brochures are required to be distributed in order to properly explain the likely causes and suggested courses of action for any motorist who fails his or her emissions inspection.

4. SUMMARY OF PROGRAM DATA

(a) Inspection Data Collection and Processing

This Portion of the report presents data primarily contained in the Department's I/M database for the period January 1 through December 31, 1990. The database contains all inspection data submitted to the Department by each of the four emission analyzer suppliers (Allen Testproducts Division, Bear Automotive Service Equipment Co., Environmental Systems Products, and Sun Electric Corporation). Specifically, the database contains emissions and safety data for each vehicle inspection performed by an emissions analyzer at each licensed inspection station in the Commonwealth. During inspection, the data are recorded onto a cassette tape which is housed within the analyzer. The cassette tapes are routinely collected by the analyzer supplier's field service technicians during monthly preventive maintenance visits. The cassettes are then copied onto a 9-track tape, which is submitted to the Department on a monthly basis. Once received by the Department, each tape is processed automatically and consolidated into the I/M database (transaction file).

Once all data tape submittals for 1990 were accounted for and their integrity ensured, the tapes were consolidated, first by month and then by quarter, so that the data could be selected and processed in the aggregate, and not only by each analyzer supplier.

The aggregated I/M inspection transaction file for program year 1990 contains upwards of 3.3 million records. Given the enormous size of the file, and the specificity of the reporting requirements, it was necessary to cull out of the database only those records which were applicable for the analyses called for in this report. This process was done by developing selection criteria based upon a number of factors such as: performance of the analyzers (i.e., the manner in which each analyzer records data onto the cassette); the inspection procedure (i.e., what data are input manually during inspection by the certified inspector); and general inspection requirements (e.g., which vehicles are "exempt" from combined safety and emissions inspection and only require a safety inspection, emissions cutpoint categories, etc.). Appendix C contains an internal memorandum which delineates the basic selection criteria for retrieving the records necessary for analysis. The I/M transaction file is in fact one of the largest databases in the Department. The records were processed by the Division of Air Quality Control, Information Systems Branch, using the State College Regency Computer Network (RCN). The Department maintains a contract with RCN annually for computer support throughout the fiscal year for anticipated demand for I/M data requests. The $5100 in computer costs cited earlier goes to RCN for their support services.

Once the selection criteria were established, over 20 separate output files were set up to handle the data as they were selected, sorted, and counted. After sorting and counting, the retest data were then processed through a program which matched records by license number to the file comprised of all initial failures for the calendar year in order to ascertain the number of vehicles which initially failed the emissions inspection and passed a subsequent retest (retest passes). Initial failures which were not matched to a retest in the initial month were saved to compare with retest passes in subsequent months. However, retest passes not matched to an initial test were not counted.

(b) Inspection Data Capture and its Impact on Data Analysis

The issue of data capture needs to be discussed in this report, as it is likely that not all data from each inspection performed were captured for analysis. Reasons for this must be considered while evaluating the data. These include factors directly related to the selection criteria described above, as well as specific I/M program compliance issues (such as non-adherence to established inspection procedures), each or in combination, as well as technical limitations of the cassette itself.

One reason for incomplete data capture may have to do with the pickup and submittal of the data cassettes. According to the contractual agreement between the analyzer suppliers and the Department, data for a particular month is to be submitted to the Department within 45 days after the close of that month, as was discussed earlier. Subsequently, cassette pickup and processing must occur in a timely manner. It has been noted that in the past not all analyzer suppliers have been vigilant in ensuring a complete data set for each monthly submittal. There have been cases where cassettes have been temporarily lost or misplaced, or were not picked up in a timely fashion. Since these cassettes were not transferred onto the monthly 9-track submittal, those data never reached the Department. Efforts have been underway to address this problem by formally instituting reporting mechanisms, and exploring allowances for submittal of "late" data in dire circumstances. The emphasis in this initiative is to clearly account for all of the data; but is expected to yield better results in program year 1991.

There are also a number of possible causes which relate specifically to physical capture of the data onto the cassette, thus creating gaps in the database. For some of the emissions analyzer models, inspections may be performed while the data cassette is removed or full, or the data cassette may have been rewound and written over, or the data cassette may have been turned over and recorded on the "B" side, but the "B" side may not have been transferred onto the 9-track tape by the

manufacturer. In addition, it is possible that, for technical reasons, invalid data or corrupt files were transferred onto the 9-track submittal. An example of this could be that the 9-track tape is incompletely written over, and there are two end-of-file (EOF) markers on the tape. While the data have been submitted, they may be unreadable or unusable in the Department's automated system.

In all cases where data capture is more or less controllable by the manufacturers, either through improved effectiveness or efficient management of cassettes or 9-track tapes, better accounting of the data is being enforced as a top priority. Part of that effort has included some technical changes to the equipment (e.g., lock-outs) that would help maximize data capture. This is discussed in more detail in Section IV. Again, in these cases data capture is expected to improve during program year 1991.

There are also several possible explanations for not achieving full data capture that point to the Certified Inspector as it relates to the quality and propriety of the data entered onto the cassette. The anomalies concerning vehicle plate match may be a direct result of simple data entry errors, where the license plate may not have been correctly entered during one of the inspections (initial or retest), thus precluding a possible accurate match during data processing. Another possibility is where a failed vehicle is repaired and reinspected at a facility different from the one at which it initially failed. It is likely to be entered as an initial inspection, and not a retest. Still another scenario is that the certified inspector may have designated the vehicle as "exempt" during the retest inspection. (This is only allowed in cases where the initial failure was a safety failure, and for the subsequent retest the emissions portion of the test is not required). The use of "exempt" in this manner, inappropriate as it may be, would have precluded the identification of that vehicle for a plate match. Efforts to include "exempt" vehicles in the retest count during data processing would not have achieved fuller data capture, as the analyzer automatically bypasses the emissions portion of the inspection once the exempt status is manually actuated and entered into the analyzer. The use of "exempt" status to inappropriately or unlawfully bypass the emissions inspection has been known to occur, and is currently being studied by the Department and the Registry.

Other possible data entry errors initiated by the certified inspector, which may have had an impact on data capture during the plate match, are summarized below. An error in ANY one digit of any parameter would similarly preclude an accurate match between a vehicle initially failing and the same vehicles passing the retest.

(1) Wrong Vehicle Model Year on either Initial or Retest
(2) Wrong Test Type ("I", for Initial, entered instead of "R" for Retest)
(3) Wrong Vehicle Type ("D" for heavy duty truck or "E" for exempt) on either Initial or Retest
(4) Wrong Fuel Type ("D" for diesel entered instead of "G" for gasoline) or either Initial or Retest
(5) Error in License Plate Number on either Initial or Retest

In cases where Department has not received the full complement of data from the analyzer suppliers (as described at the beginning of this section), data gaps and unmatched data sets do exist, thus preventing an accurate plate match between initial failures and retest passes. This could result in retests which cannot be matched up to an initial inspection, as well as initial inspections not matching up to a retest. Finally, in cases where an initial failure occurred in December, the matching retest may not have occurred until January of the following year. In that case, the data for the retest are on a different year's data file, and will not be matched to the initial inspection data.

In addition, it could be that during transcription of data from the data cassettes to the 9 track tape, certain cassettes may have inadvertently been transcribed twice. In this case, the number of any unmatched inspections on that cassette would be doubled.

While data capture has an immediate effect on the numbers of inspections and inspection passes and failures, the issue as to whether there is an actual effect on the rates presented below is less clear. Efforts to more adequately characterize data capture and the effect it may have on reporting are currently underway. As part of such an assessment, two associated issues must be examined. The first relates to whether an acceptable data capture rate, and conversely, an acceptable data loss, can be reasonably derived. Second, if such can be achieved, what significance can be attached to the acceptable data loss rate in terms of program effectiveness. Given the very nature of a decentralized I/M Program, a certain amount of data will be lost, or forever misplaced, somewhere along the way. Any attempt to achieve 100% data capture may ask the impossible, and it is at what cost in time and resources? In directing all program efforts at achieving full data capture, would it not take time away from data analysis activities and other vital program operations? Current resource constraints demand a balanced perspective so as to have the time to examine the program's effectiveness.

(c) Inspection Data

The sheer volume of the inspection transaction data base is such that, due to budgetary and technological constraints, it is difficult to perform what would appear to be a simple accounting and characterization of all transactions. Figure III-3 presents a breakdown of the 3,353,153 inspection transactions contained in the transaction file by inspection type. Since all 3.3 million transactions, including initial tests, retests, and exemptions, are stored in one data system, it is imperative that in analyzing the data the intricacies of the operation of the analyzers, as well as the inspection procedures, are taken into account. Possible abuses of the system, i.e., methods to sidestep a full emissions inspection, should also be considered when analyzing the data. Several such considerations were taken into account during data analysis, as described below.

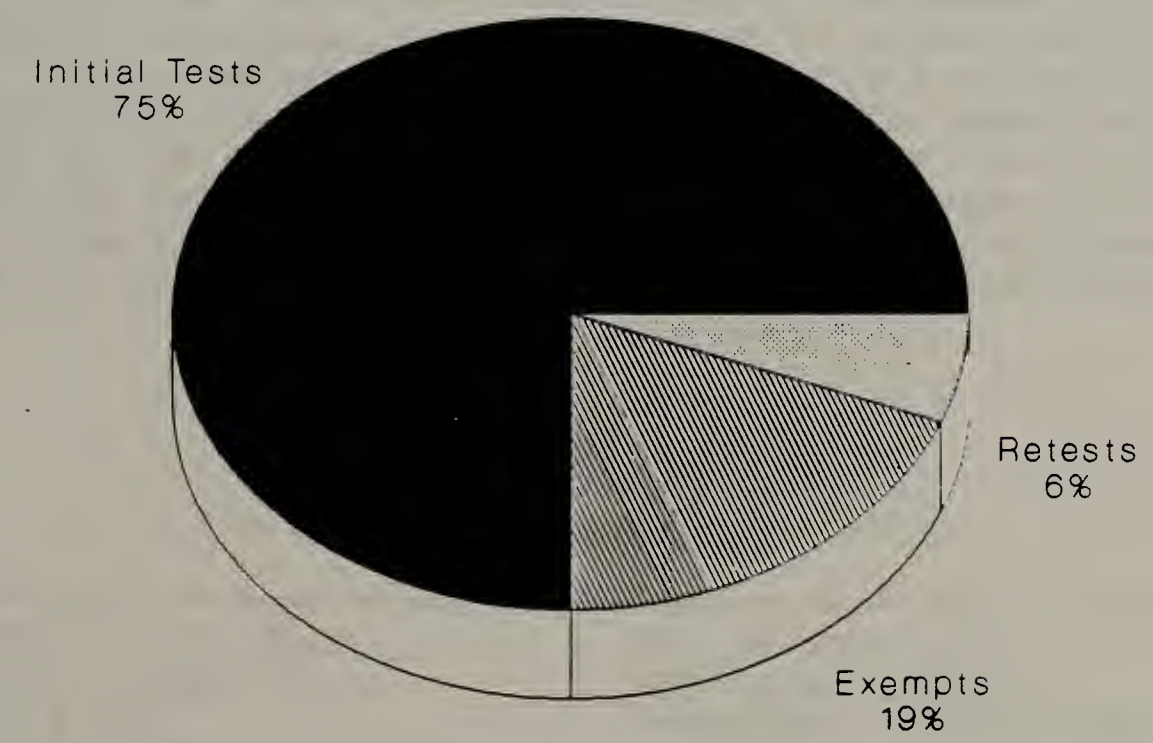
During data processing, efforts were made to more accurately characterize the number of vehicles receiving initial inspections, as opposed to reporting merely the number of initial inspection transactions. This seemed necessary, as a trend had been identified in the database in which vehicles were receiving multiple, consecutive initial inspections. Accordingly, the data processing program was set up first to count all the initial inspections performed, and then to select and count only the last initial inspection in cases where a vehicle is repeatedly tested. There is a 5% discrepancy between these two figures for the 1990 data, as 2,530,957 initial inspections appear to be performed on 2,411,784 vehicles. The reasons for this are not clear. A vehicle may have failed the inspection and was then given minor adjustments in the inspection bay and immediately retested as an initial inspection. Or perhaps this reflects inappropriate practices with respect to established inspection procedures. Future program operations efforts will be directed towards further characterizing and rectifying these discrepancies. However, for the purposes of this report, and to evaluate program effectiveness, a more appropriate base figure from which to work is the number of vehicles receiving initial emissions inspections, i.e., 2,411,784.

Efforts were also made towards characterizing the exempted vehicles, and to assess whether there is a common practice of illegally exempting vehicles which should undergo an emissions test from the procedure. The data indicate that, of the initial tests, 72,167 vehicles, or 3%, were improperly exempted. Of the 81,224 retests matched to an initial test through the license plate, 2517 vehicles, also comprising 3%, were improperly exempted.

As a result of these findings, monthly data screenings are being instituted during the processing of the 1991 data in order to better assess the magnitude of the problem, and to direct

Figure III-3
1990 Inspection Transaction File

Breakdown of File by Transaction Type for 3,353,153 Inspections



enforcement efforts towards bringing stations which have demonstrated apparent abuse of the inspection procedure into compliance.

Table III-4 describes the number of vehicles registered in the Commonwealth by the Registry of Motor Vehicles during calendar year 1990 versus the number of vehicles receiving an initial emissions inspection. Since emissions inspections are only required of light duty, gasoline powered vehicles which are less than 15 model years of age, a considerable percentage of the registered motor vehicle fleet are not subject to the emissions inspection requirement, hence one explanation for the discrepancy between the two numbers. Also not included in the vehicles requiring emissions inspections are diesel-powered vehicles, trucks with a curb weight of greater than 8500 lbs., motorcycles, and new vehicles purchased within its respective model year but no greater than 12 months old. As mentioned previously, the use of "exempt" status to inappropriately or unlawfully bypass the emissions inspection has been known to occur, and it is possible that a number of vehicles have been so exempted and may therefore be accounted for in this number. It is also possible that the number of vehicles registered may actually represent the number of registration transactions, as opposed to actual registered vehicles. These explanations may account for a sizable portion of the difference between the two numbers. The most compelling reason for the bulk of the discrepancy, however, most likely has to do with the data capture issue mentioned previously. The available data indicate that at least 57.7% of registered Massachusetts vehicles received an initial emissions inspection in 1990.

TABLE III-4
Number of Vehicles Requiring
and Receiving Inspections
(January 1 - December 31, 1990)

NO. OF VEHICLES REGISTERED BY THE RMV	NO. OF VEHICLES RECEIVING INITIAL EMISSIONS INSPECTIONS
4,181,476	2,411,784

Table III-5 presents a breakdown of initial inspection passes and failures in 1990 by cutpoint category. The cutpoint categories were established to achieve the I/M Program's emission reduction targets, and correlate with the increasing stringency required of emission control equipment installed in vehicles as required by the EPA. The overall initial non-safety failure rate

was 12.0%, while a breakdown of the rates by cutpoint category indicated a larger spread, the highest being a 19.4% failure rate for the 1976-1979 fleet. This is consistent with data reported from the 1987, 1988, and 1989 program years. These failures represent the full complement of emissions failures, i.e., exceedances of the established hydrocarbon (HC), and/or carbon monoxide (CO) cutpoints (emissions failures), as well as the carbon dioxide (CO2) leak check, and the idle check (RPM). It should be noted that the latter two are built in lock-out features to the analyzers and do not constitute true emissions failures. The emissions test is in fact precluded from being completed until the CO2 or RPM malfunction is corrected. Non-safety failures do not include the inspection of the fuel filler neck restrictor or the catalytic converter. Failures in these categories are not treated as emissions failures in the database, as they are visual inspections rather than functional tests.

TABLE III-5
Number of Vehicles Receiving
Inspections by Cutpoint Category
(January 1 - December 31, 1990)

CUTPOINT CATEGORY	NO. INITIAL INSPECTIONS	NO. PASSING INITIAL INSPECTION	NO. NON-SAFETY FAILURES	FAILURE RATE (%)
1981+	2,061,751	1,838,330	223,421	10.8
1980	93,729	77,425	16,304	17.4
1976-1979	256,304	206,677	49,627	19.4
TOTAL	2,411,784	2,122,432	289,352	12.0

The non-safety failures are further broken down in Table III-6. There is a wide spread across cutpoint categories for emissions. The fleet of vehicles for model years 1976-1979 has the highest failure rate for emissions, at 13.4%, nearly twice that of the rate for the 1981+ fleet. Overall, the emissions failure rate is low, at 7.7%, and spans a range from 6.9% to 13.4% across cutpoint categories. The CO2/RPM failures, as a percent of total inspections, is very consistent across the 1980 and 1976-1979 cutpoint categories, the 1981+ fleet having a slightly lower rate.

TABLE III-6
Breakdown of Non-Safety Failures
by Type and Cutpoint Category
(January 1 - December 31, 1990)

CUTPOINT CATEGORY	NO. EMISSIONS FAILURES*	% OF TOTAL INSPECTIONS	NO. CO2/RPM FAILURES	% OF TOTAL INSPECTIONS
1981+	141,352	6.9	82,069	4.0
1980	10,567	11.3	5,737	6.1
1976-1979	34,365	13.4	15,262	6.0
TOTAL	186,284	7.7	103,068	4.3

* Includes HC and/or CO failures

Data on those vehicles which failed the initial emissions test and subsequently passed a retest (presumably after remedial work such as a tune-up) are presented in Table III-7. It has been noted that the number of initial failures does not match the number of retested vehicles reported. In fact, the overall retest pass capture rate appears to be quite low, at 41.3%. This continues a trend of a slight, continual lowering of the retest pass capture rate since 1987 (45.4% in 1987, 43.6% in 1988, and 42.8% in 1989). There are a number of reasons why a failed vehicle may not have a follow-up retest pass. Many of these reasons have been discussed in the data capture section, and include a series of data-entry errors on the part of the certified inspector (i.e., typographical errors which prevent a plate match during data processing), inappropriate use of the "exempt" status, erroneous use of the "initial" versus "retest" status, and incomplete data cassette-to-9-track submittals.

There is also a population of vehicles which may have, in fact, failed an initial inspection and never received a retest. These vehicle may, in the interim, have been in an accident and junked, stolen, put into storage, or moved to another state. It is also possible that the owner of the failed vehicle may have secured a certificate of inspection through other means, and not through the typical retest procedure route. All combined, they may artificially inflate the number of initial inspections and suppress the true retest pass rate. Given the quantity and the configuration of those data, it may be impossible to determine the exact number or to discern the precise causes among them all.

Despite apparent concerns regarding the retest pass capture rate, the remarkable consistency across all cutpoint categories is important to note. It should also be noted that the overall

rate of initially failed vehicles which did not pass the retest (58.7%) actually represents a much smaller percentage of the universe of vehicles receiving initial inspections, i.e., 4.5%. This number is only slightly lower than the corresponding, but consistent, figures for 1987, 1988, and 1989 (5.6%, 5.4%, and 5.0%, respectively).

TABLE III-7
Breakdown of Failures and Matched
Retest Passes by Cutpoint Category
(January 1 - December 31, 1990)

CUTPOINT CATEGORY	NO. OF INITIAL EMISSIONS FAILURES (HC/CO)	NO. OF MATCHED RETESTED VEHICLES CAPTURED (%)	NO. OF MATCHED RETEST PASSES CAPTURED (%)
1981+	141,352	61,782 (43.7%)	58,418 (41.3%)
1980	10,567	4,646 (44.0%)	4,398 (41.6%)
1976-1979	34,365	14,796 (43.0%)	14,053 (40.9%)
TOTAL	186,284	81,224 (43.6%)	76,869 (41.3%)

Table III-8 presents data on the number of inspection certificates, waivers, and temporary maintenance forms issued by the Registry in 1990. Inspection certificates do not include certificates of rejection. Unused Inspection Certificates are returned to the Registry, and are not resold. Certificates of Rejection are not sold, but rather are given out by the Registry. There is no formal bookkeeping mechanism at the Registry which tracks the number of unused Inspection Certificates returned, nor the number of Rejection stickers actually issued in 1990.

(d) Analyzer Audit Data

The Registry and the Department jointly conduct quality assurance of the analyzers in the field through the emissions analyzer performance audit program. Results of the analyzer audit program are contained in Section III-5 of this report.

TABLE III-8.
Summary of Certificates Issued on Vehicles;
Inspections, Waivers, And Temporary Maintenance Forms
(January 1 - December 31, 1990)

TYPE OF CERTIFICATE	NUMBER
Inspection Certificates Sold	4,294,041
Waivers	407
Temporary Maintenance Forms	5

(e) Compliance and Enforcement Data

As stated earlier, the I/M program is jointly administered by the Department and the Registry. While the Registry is primarily responsible for compliance and enforcement activities at the inspection stations, on the road, and concerning motor vehicles in general, the general oversight, management, administration, and day-to-day operations of the emissions inspection program are the responsibility of the Department.

A summary of Registry compliance and enforcement activities at the licensed inspection stations is presented in Table III-9. The number of routine station visits includes all classes of station (A, B, C, and D). Class A stations are public inspection stations for safety and emissions inspections, stations with a class B license conduct fleet inspections for safety and emissions, class C stations are fleet inspection stations for safety inspections only, and those public inspection stations which perform safety only inspections hold a class D license. According to Registry figures, there were 362 class C stations and 98 class D stations in 1990.

(f) Other Operations Data

There are other types of data searches and requests which involve the inspector file and the station file. These requests are handled directly by the Area Programs Implementation Branch, and can be processed in a much shorter period of time. Timely responses to all data requests, however, require timely data acquisition. Any delays in the submittal of a 9-track tape by a manufacturer, for example, could impact the turnaround time on an enforcement case.

TABLE III-9
Summary of Station Compliance Activities
(January 1 - December 31, 1990)

ACTIVITY	NUMBER
Licensed Inspection Stations	2849
Station Revocations	5
Station Suspensions Issued	240
Covert Station Visits	115
Courtesy Cards Issued	188
Routine Station Visits	18,397

In November, 1990, as part of the Department's effort to enhance its quality assurance/quality control with regard to emissions inspections, a new Inspector Certification and Recertification Program was instituted. This effort is discussed in more detail in Section IV, but Table III-10 illustrates the number of certifications and recertifications issued under the new program during 1990. A copy of the Inspector Certification Form is contained in Appendix D.

TABLE III-10
Breakdown of Inspector Certifications
and Recertifications
(November 3 - December 31, 1990)

TYPE	NUMBER	% OF TOTAL
New Inspectors Certified	981	81.2
Current Inspectors Recertified	227	18.8
TOTAL ISSUED	1,208	

5. EMISSIONS ANALYZER AUDIT PROGRAM AND ANNUAL SUMMARY REPORT (January 1, 1990 - December 31, 1990)

(a) Introduction

The Massachusetts Emissions Analyzer Audit Program was first introduced on April 1, 1986. The Program is designed to assess and determine the accuracy of the emissions analyzers in reading known concentrations of specific test gases which simulate automotive exhaust, and to assess the overall performance of the analyzers in the field.

The Analyzer Audit Program is an integral part of the quality assurance (Q/A) program for the state's vehicle Inspection and Maintenance (I/M) Program, as detailed in the Quality Assurance Plan for the Automobile Emissions Inspection and Maintenance Program (February, 1990). It was developed by the Department of Environmental Protection with support and participation from the Registry of Motor Vehicles, and guidance from the U.S. Environmental Protection Agency. The Registry is responsible for conducting initial audits on all state approved analyzers in use twice per year. The Department is responsible for reauditing all analyzers which fail the initial audit for gas-related failures (HC and/or CO). The Department provides technical training to Registry auditors on the use of the audit equipment. The Department also designs, purchases, and supplies the audit equipment to the Registry.

There are six approved emissions analyzer models which are produced by four manufacturers (Allen Testproducts Division, Bear Automotive Service Equipment Co., Environmental Systems Products (formerly Hamilton Test Systems), and Sun Electric Corporation) for use in the I/M Program.

The data in this report, which was obtained from 2,497 audits performed during 1990, were generated from a database using dBASE III PLUS. Until September, 1990 the audit data were stored and analyzed using a Lotus spreadsheet/database. The Department decided that the Lotus application was limited, and that an enhanced data management systems would better serve the program's needs. In order to initiate such improvements, the Analyzer Audit forms and Cease and Desist Order forms were examined to scope out which data fields would be critical for the database. A database structure was then developed from the selected data fields. Separate data entry applications were designed and developed for analyzer audit forms and unsigned and signed Cease and Desist Order forms, taking into account field audit and repair procedures. A training manual for data entry was developed for in-house use. While the Initial Audit Form and the Cease and Desist Order Form are multi-copy, carbonless forms, example copies of each can be found in Appendices D and E, respectively.

The dBASE database differs from the Lotus database in that much more information from the forms can be accommodated and manipulated for data analysis. For example, separate data fields have been created for each failure item and repair code, thus allowing the user to generate reports on these specific fields if desired. This allows the Department to better track audits, and will allow for more in-depth data analysis. The new database is now powerful enough to quickly process the large quantity of data generated by the audit program.

(b) Initial Audit Results

Summary results of initial audits performed by the RMV for the period 1/1/90 - 12/31/90 are described in Table III-11. The overall analyzer failure rate was 12.3% for this period. Since this is the first report for a calendar year (Previous analyzer audit reports were issued each federal fiscal year quarter. The change was initiated to allow for more direct comparisons on the other program elements which otherwise occurred routinely on a calendar year basis.), the failure rate for this report cannot be directly correlated to previous annual reports.

TABLE III-11

SUMMARY OF INITIAL RMV AUDITS
(1/1/90 - 12/31/90)

INITIAL AUDITS	NUMBER PASS	PERCENT PASS	NUMBER FAIL	PERCENT FAIL
2497	2191	87.7%	306	12.3%

An analyzer can fail an audit for one or more reasons. These include problems with gas calibration (HC, CO, or both (HCCO)), and non-gas related problems such as faulty probe tip or hose, inaccurate date, leaks in the system (Leakcheck), printer failure and failures included in the "Other" category indicated on the Analyzer Audit forms and Cease and Desist Order forms. These "Other" failures include: internal calibration failures, lack of a PEF number (Propane Equivalency Factor) which is required by regulation to be labeled on each tank of calibration gas and is used to calculate the HC and CO emissions during an analyzer audit, and incorrect time which indicates that the internal clock in the analyzer needs to be adjusted.

(c) Number of Initial Audits Based on Failure Type

Table III-12 shows the number of audits that failed based on failure type. One hundred and fifty-five, or 50.7% of the initial audit failures are solely due to gas-related items. Sixty-seven initial audits failed due to non-gas items only, comprising 21.9% of the failures. Eighty-one initial audits failed for both gas and non-gas items, comprising 26.4% of the total failures. Overall, 236 or 77.1% of the 306 failed initial audits failed due to gas related problems.

Of the 236 gas failed audits, 79 audits failed for HC only, 31 audits failed for CO only, and 126 audits failed for both HC and CO. Previous audit reports also indicate that the majority of gas failed audits fail for both HC and CO. These data indicate that when an analyzer fails an audit because of a gas failure, it appears that it is due primarily to failures in both HC and CO.

TABLE III-12

NUMBER OF FAILED INITIAL AUDITS BASED ON FAILURE TYPE
(1/1/90 - 12/31/90)

TYPE OF FAILURE	NUMBER OF AUDITS	PERCENT OF FAILED AUDITS (306)	PERCENT OF INITIAL AUDITS (2497)
Gas only	155	50.7%	6.2%
Non-gas only	67	21.9%	2.7%
Gas & Non-gas	81	26.4%	3.3%
Unknown*	3	1.0%	0.1%
TOTAL	306	100.0%	12.3%

* For three audits, only a Cease and Desist Order was submitted to the Department, and failure information is not indicated on these forms.

(d) Frequency of Analyzer Failure Items

* Frequency of Gas Failure Items:

Table III-13 shows the total frequency for each gas failure item for the initial audits by manufacturer. The highest failure rate items were HC, with 205 failures comprising 8.2% of total initial audits, and CO, with 157 failures at 6.3% of total initial audits. Fifty-seven percent (57%), of the total gas failure items (362), were for HC. In previous audit reports HC failures also predominated in frequency with a range from 52% to 60%.

While Environmental Systems Products (ESP) analyzers appear to have had the highest frequency of HC and CO failures, it should be noted that 65% of the initial audits were performed on ESP analyzers. If, however, the frequencies are weighted based on the number of analyzers audited for all four analyzer manufacturers, Bear analyzers have the highest gas failure rate.

TABLE III-13

BREAKDOWN OF VARIOUS FAILURES AND THEIR FREQUENCIES FOR INITIAL AUDITS PERFORMED
(Total Failures and Manufacturer Breakdown)
(1/1/90 - 12/31/90)

FAIL ITEM	FREQUENCY	FAILURE * RATE (%)	ALLEN	BEAR	ESP	SUN
HC	205	8.2%	7	65	126	7
CO	157	6.3%	7	47	95	8
PROBE TIP	38	1.5%	0	30	5	3
DATE	21	0.8%	1	3	15	2
LEAKCHECK	65	2.6%	1	25	34	5
PRINTER	29	1.2%	1	6	21	1
OTHER	27	1.1%	1	3	22	1

* Frequency of failures for each fail item divided by total initial audits (2,497)

* Frequency of Non-Gas failure Items:

Table III-13 also contains data on frequency of non-gas failure items. Probe tip and leakcheck failures were isolated from the "Other" category and included as separate items in the table due to their frequent occurrence. The reader is therefore cautioned not to compare the numbers for the "Other" category to those in previous audit reports, since probe tip and leakcheck were included in the "other" category in past reports.

Leakcheck failures (64) were the most frequent non-gas failure item. A leakcheck failure indicates that calibration gas is leaking from the analyzer's pneumatic system. Leakcheck failures that occur during the "Initial check" of the audit shut down the analyzer, and prevent the auditor from obtaining any HC or CO values. Most of the leakcheck failures, though, occurred during the "Recheck" portion of the audit procedure when a gas item failed. In general, Analyzer printers (29) failed often and were either repaired or replaced, and the Date (21) that is displayed on the analyzer terminal was often incorrect and had to be adjusted.

There were 27 failure items that were accounted for under the "Other" category as follows: electrical calibration (4), gas calibration (4), automatic calibration (2), incorrect time (6), incorrect or lack of PEF # (4), glass filter bowl (2), miscellaneous (4), and unknown (1). Since leakcheck and probe tip comprised a high percentage of the "Other" failures in previous reports, it is not surprising that the "Other" fail item had a lower failure rate in this report (1.1%), as compared to past audit reports.

(e) Initial Audit Results by Manufacturer

A breakdown of initial audits and pass/failure rates by manufacturer is presented in Table III-14 below.

As mentioned earlier, the failure rates for each analyzer manufacturer in this report should not be strongly correlated to failure rates in previous reports since the number of initial audits vary widely for each report. This is the first reporting period where the majority of the state's 2,246 analyzers were audited at least once. 1,704 analyzers were audited once and 360 analyzers were audited two or more times. A breakdown of the 360 analyzers show that 331 analyzers were audited twice, 27 analyzers were audited three times, and 2 analyzers were audited four times. A total of 542 analyzers, or 24% of the analyzers, were not audited at all in 1990.

TABLE III-14

BREAKDOWN OF INITIAL AUDIT
RESULTS BY MANUFACTURER
(1/1/90 - 12/31/90)

	NUMBER OF ANALYZERS	NUMBER AUDITS	PERCENT AUDITED	NUMBER PASS	PERCENT PASS	NUMBER FAIL	PERCENT FAIL
LLEN	51	58	113.73%	47	81.0%	11	19.0%
BEAR	363	403	111.02%	315	78.2%	88	21.8%
ESP	1451	1633	112.54%	1442	88.3%	191	11.7%
SUN	381	403	105.77%	387	96.0%	16	4.0%
OTAL	2246	2497	111.18%	2191	87.7%	306	12.3%

Department records indicate that there are 2339 analyzers in the field. At present, however, during quality assurance and quality control of analyzer location lists, 153 analyzers in the field have not been positively associated with a manufacturer specific analyzer.

Bear analyzers, in this report and previous reports, continue to have the highest failure rate compared to the other manufacturers. However, Bear has shown a drop in its failure rate to 21.8%, which is considerably lower than the 30.8% rate reported in 1989. Sun analyzers showed the lowest failure rate, at 4.0%. This is the lowest failure rate that has been reported for any manufacturer over the previous two years. Sun's failure rate has steadily decreased over the last two years (from 12.9% to 8.1%). Allen analyzers had a failure rate of 19.0% which is slightly higher than the previously reported failure rates. ESP's failure rate of 11.7% appears consistent with the range of rates reported in the previous four audit reports (ranges = 10.8% to 17.4%).

It should also be noted that the reported numbers of analyzers per manufacturer (i.e., the denominator for determining the failure rates) has been updated from the previous audit reports. This number will likely change in subsequent reports, as the Department is currently enhancing its databases and database applications. The Department is also working with the manufacturers to ascertain the most accurate count of analyzers currently operating in the field. Due to ever changing factors such as contract cancellation, as well as the addition of new stations entering the inspection system and stations deciding to leave the program, the exact number of analyzers operating in the inspection program can actually vary on a monthly basis.

(f) Repairs to Failed Analyzers

After an analyzer fails an audit, a Cease and Desist Order is issued. The inspection station is informed of the fact that the analyzer cannot be used for inspection purposes until an analyzer manufacturer service representative repairs the analyzer. When this service call occurs the service representative indicates on the Cease and Desist Order which repairs were performed, and sends the signed Cease and Desist Form containing this information to the Department.

* Quality and Quantity of Analyzer Repair Data:

The Department, via the new database system, has a better accounting of analyzer repairs compared to previous reports. At the same time, however, upon closer scrutiny, a number of qualitative and quantitative issues regarding the data entered on the signed Cease and Desist Orders have come to light, and are now in the process of being addressed.

* Quantity of Analyzer Repair Data:

During routine quality assurance of the audit data using the new data system it was discovered that a large percentage of signed Cease and Desist orders were never received by the Department. There are two major reasons why this may be happening: either the Cease and Desist Orders are somehow misplaced either by the station operator or service representative, or the service representative may not have visited the location of the failed analyzer. It appears that in most cases the paperwork is misplaced. For example, in the first quarter of 1991 the Department sent each analyzer manufacturer a list of missing signed Cease and Desist Orders, and asked for an accounting of them. The manufacturers subsequently tracked and returned more than 50% of the missing orders. This report therefore, contains more repair information than was recovered for previous audit reporting periods. The Department plans to routinely send lists to the manufacturers in order to account for missing signed Cease and Desist Orders. However, the Department also has impressed upon each manufacturer the urgency of receiving this information. The Department has indicated that continued failure to do so will result in more serious enforcement action, including penalties.

Table III-15 below shows the number of signed Cease and Desist Orders the Department has received from each manufacturer.

TABLE III-15

NUMBER OF SIGNED CEASE AND DESIST ORDERS RECEIVED

Analyzer Mfr.	No. of failed Initial Audits	No. of signed C/D Orders (%)	No. of missing signed C/D's (%)
Allen	11	6 (2%)	5 (45%)
Bear	88	48 (26%)	40 (45%)
ESP	191	176 (73%)	15 (8%)
Sun	16	12 (5%)	4 (25%)
(Totals)	306	242	64 (21%)

* Quality of Analyzer Repair Data:

After carefully examining the repair information provided by the various service representatives on each signed Cease and Desist Order, a number of difficulties became apparent in interpreting the meaning of the data checked off in the repair boxes and the comments in the "Other repair" comment line. This is largely due to the fact the data are generated from a large number of service representatives, each with his own interpretation as to the meaning of the various repair codes. For example, while some service technicians would check off "electrical calibration", others would write in "recalibrate" in the "Other repair" box for the same repair. When "recalibrate" is written in it is unclear as to exactly what component is being recalibrated, (e.g., the bench). It may be that when "electrical calibration" is checked off the service representative actually performed a more specific calibration. In addition, many service technicians perform certain repairs and calibrations, but do not indicate them on the Cease and Desist Orders. The following repairs: electrical and general calibrations, examination of analyzer tubing, hoses, pumps and a follow up leakcheck test, seem to be standard protocol when a gas failure has occurred. There are, however, a large number of Cease and Desist Orders that don't indicate the above repairs when a gas failure occurs. Plans are underway to better standardize the manner in which these forms are completed, through discussions and training sessions with the analyzer manufacturers.

Table III-16 describes the various types of repairs which were performed on analyzers failing initial audits for the period 1/1/90 through 12/31/90. If an analyzer fails the audit for more than one reason, it will require several types of repairs. Accordingly, more than one repair code will be indicated for that analyzer. Table III-16 does not necessarily represent the full

TABLE III-16

BREAKDOWN OF REPAIR CATEGORIES FOR INITIAL AUDIT FAILURES (1/1/90 - 12/31/90)

TYPE OF REPAIR	FREQUENCY	(BREAKDOWN OF FREQUENCY BY MFR.) ALLEN	BEAR	ESP	SUN
DATE/TIME	15	0	1	12	2
BENCH	49	1	2	44	2
ANALYZER DOWN	5	0	4	1	0
ELECTRICAL CALIBRATION	45	2	0	36	7
PROBE TIP/HOSE	36	0	18	13	5
FILTER BOWL	25	1	1	23	0
LEAK CHECK	17	1	6	6	4
OTHER	154	3	38	106	7
STATION SUSPENDED	2	0	0	2	0
VACUUM SWITCH	12	0	0	12	0

range of repairs for all failed analyzers for the reporting period, since 64 completed Cease and Desist Orders, which document the specific repairs performed, were not received by the Department at the time of this writing.

* Frequency of Analyzer Repair Items:

In Table II-16, the single most common repair item documented on the signed Cease and Desist Orders was "Bench" (49). The infrared bench is a critical component of the analyzer, which actually performs the gas analysis and renders the determination whether a particular test passes or fails. It is a unit in which a sample of the exhaust gas from a vehicle is compared to a reference gas, with a known value, to determine whether it is above or below that value. Since "bench" is a checked off item on the Cease and Desist Form, it is difficult to determine if a bench was replaced, repaired, or calibrated. A

histograph of these repairs is shown in Figure III-4. The second most common repair made to the analyzers was "electrical calibration" (45). As mentioned earlier in the "Quality of Analyzer Repair Data" section, it would be interesting to know how many of these are calibrations other than electrical. Regardless of the type, it is apparent that analyzer calibration is a common practice. Probe tip/hose repairs (36) were also common. Bear analyzers had the highest repair rate (18) for probe tip/hose. The replacement of filter bowls (25) were almost entirely done on ESP analyzers (23). Leak check tests (17) are much lower than the 65 leakcheck failures that occurred. The service representatives are either failing to document leakcheck tests after completion or they are not being done. Table III-15 indicates that most of the repairs were made on ESP analyzers. Again, this may be attributed to the fact that 73% of the analyzers repaired were ESP analyzers.

One hundred and fifty-four repairs were indicated under "Other" repairs. Many analyzers had more than one repair item indicated. Repair comments are also often illegible. A histograph of these repairs is contained in Figure III-5. Most of the repairs were made on the internal plumbing system of the analyzer. A high number of repairs were made on pumps (15) and diaphragms (12). The diaphragm is the rubber valve in the pump that creates the pressure inside the analyzer's plumbing system. In most cases the pump was replaced or repaired, or the diaphragm was ripped and had to be replaced. There were also high replacement rates for filters (12), rubber tubing (12), hoses (7), S-pipe/hoses (5), and exhaust hoses (4). Apparently the reason so many leakcheck failures occur is that the tubing, hoses, pumps, pump diaphragms, and filters, which are the internal plumbing system of the analyzer, become clogged, or deteriorate over time. Other items that were replaced or repaired frequently were: printers (15), and solenoids (11). Once the physical repairs are made on the analyzer, the service representative must carry out various calibrations to the bench and other electrical and non-electrical components in the analyzer. Any mention of calibrations other than electrical calibration were tallied under "general calibrations" (14).

On 12 Cease and Desist Orders the service representatives indicated that "no problem was found" with the analyzer, yet these same representatives did not indicate if any calibrations were carried out to reach that conclusion. There were also 6 signed Cease and Desist Orders that did not indicate any repairs to the analyzer.

(g) Response Time for Repairs

Of the 242 analyzers repaired by the manufacturer service technicians, 104 or 43% of the analyzers were repaired on the same day they failed, 89 or 37% of the analyzers were repaired on

Figure III-4
Breakdown of Repair Categories for Initial Audit Failures

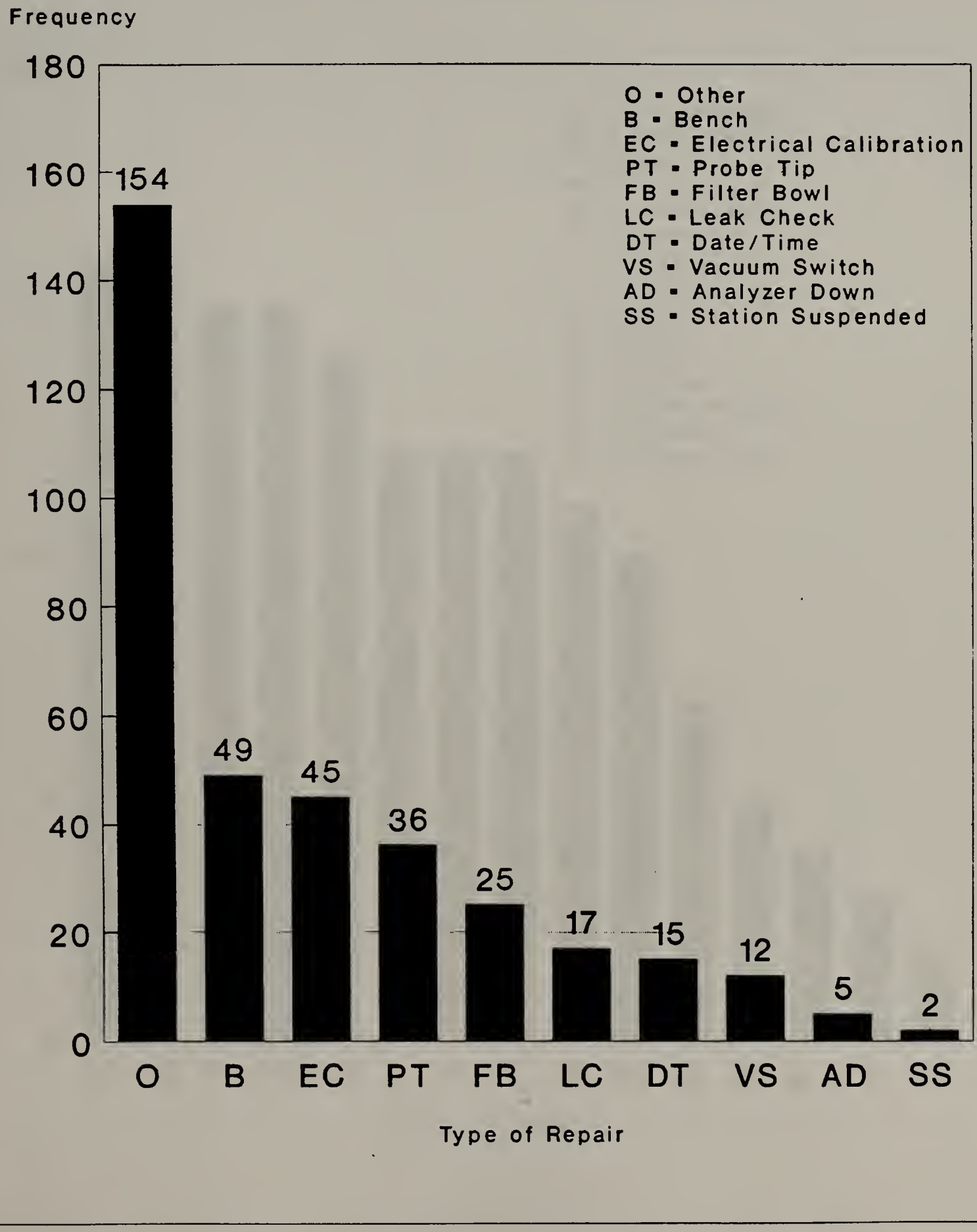
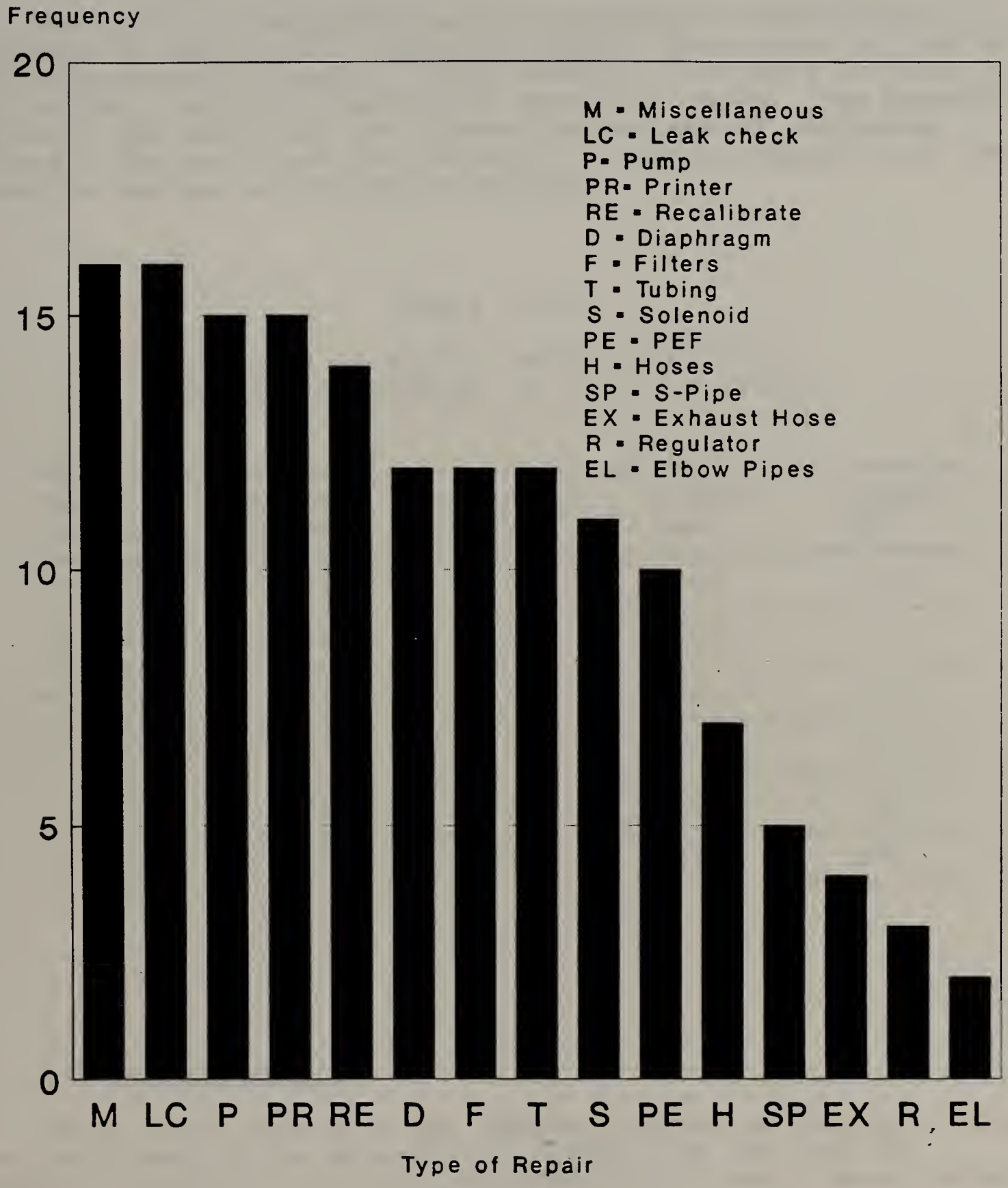


Figure III-5
Breakdown of "Other" Repairs for Initial Audit Failures



the following day, 9 or 4% of the analyzers were repaired on the second day, 16 or 7% were repaired on the third day, and 23 or 9% were repaired after 4 or more days. The Department's contract with the analyzer manufacturers requires them to respond within 3 days for service. The data indicate that in 91% of the cases this requirement is met.

(h) Initial Audit Results by Geographic Location

Table III-17 characterizes the geographic distribution of analyzers in the field by Registry region, the number of initial audits performed by region, the percent of analyzers audited in each region, and their respective pass/fail rates. The Western region of the state had the highest percentage of analyzers audited. The Northeast and Metropolitan Boston regions had the lowest percentage of analyzers audited.

TABLE III-17

BREAKDOWN OF INITIAL AUDIT RESULTS BY GEOGRAPHIC LOCATION (1/1/90 - 12/31/90)

RMV REGION	ANALYZERS /REGION	NUMBER OF AUDITS	NUMBER PASS	NUMBER FAIL
CENTRAL	415	510	456	54
M-BOSTON	501	486	426	60
NORTHEAST	515	466	411	55
SOUTHEAST	534	563	480	83
WESTERN	281	472	418	54
TOTAL	2246	2497	2191	306

(i) Reaudit Results

Table III-8 describes the summary results of reaudits which were performed by the Department, Division of Air Quality Control, Air Quality Surveillance Branch for 1990. Reaudits are

performed by the DEP reaudit team only when a gas-related failure occurs during an initial audit (i.e., HC and/or CO failures). This accounts for the discrepancy between the 306 initial audit failures in Table 17, and the 230 first reaudits performed. As the data in the Table indicate, all but one of the analyzers which failed the first reaudit were found to be within calibration after the second reaudit. The Department reaudit team acts in a QA capacity, and evaluates and reports information to the Department on the performance of specific analyzers in the field. It also tracks Analyzer Audit and Cease and Desist Orders forms that have not been properly completed, and offers training assistance to Registry inspectors.

TABLE III-18
SUMMARY OF REAUDITS
(1/1/90 - 12/31/90)

	NUMBER REAUDITS	NUMBER PASS	PERCENT PASS	NUMBER FAIL	PERCENT FAIL
1ST REAUDIT	230	191	83.0%	39	17.0%
2ND REAUDIT	39	38	97.4%	1	2.6%
3RD REAUDIT	1	0	0.0%	1	100.0%
4TH REAUDIT	1	1	100.0%	0	0.0%

(j) Summary:

During the period 1/1/90 through 12/31/90, 2497 initial audits of emissions analyzers were performed by the Registry, and yielded a failure rate of 12.3%. Of the 306 failures, 230 were gas-related and required a follow-up audit by the Department. Eighty-three percent of the initial gas calibration problems were corrected after the first service repair. Improvements in the data management system allowed the Department to better analyze the data for both quantitative and qualitative purposes. A number of issues regarding the quality of data generated by the audit program surfaced. These included the comparability of analyzer repairs documented by service representatives and the rate of return on the signed Cease and Desist Orders. Steps have been taken to ensure a higher data capture rate and to ensure more consistency in the filling out of signed Cease and Desist Orders.

IV. PROGRAM CHANGES

While attempting to maintain a consistent day-to-day I/M Program operations, the Department has initiated a process of program self-analysis. Continuing a process that began in 1989, the agency identified a number of areas within the program in need of change. In fact, these areas were noted by the agency at the time of the Program Audit conducted by EPA in the summer of 1989. They include the key areas where the I/M program has been deficient in the past, such as the oversight of analyzer manufacturers and the contracts they each have with the Department, the analyzer audit program and the analyzer audit database, and oversight of the inspection stations and certified inspectors. The following describes actions taken by the Department during the 1990 Program Year.

1. MANUFACTURER OVERSIGHT

In 1988, the contracts between the Department and the analyzer manufacturers began to expire upon their respective fifth anniversaries. They expired without a great deal of attention. In late 1989, an effort was begun to revise and reissue these contracts, which were all completed by early 1990. This effort facilitated a comprehensive performance examination of each manufacturer. Following a generic in-house review of analyzer manufacturer performance, a letter was sent to the corporate offices of each analyzer manufacturer. This letter was followed by scheduling full-day meetings with each manufacturer in the Division's Boston office. The meetings occurred throughout the summer of 1990 and were attended by Department staff at all meetings and Registry staff at two of those meetings. Each manufacturer was represented by an appropriately configured delegation so that each major issue could be discussed and decisions made, if need be. A summary of each meeting was made and issued in the form of a letter to each manufacturer fashioned such that part of the letter was generic to all manufacturers and the remainder specific to individual manufacturers. In these letters, manufacturers were ordered to perform or complete certain activities or functions within a specified period of time. In brief and in part, the letter addressed the following: submittal of inspection data tapes in a complete, careful, and timely manner; analyzer audit activities are followed up and accurately reported to the Department in a complete and timely manner; strict adherence to various requirements specified in the Technical Specifications; installation of software that activates a lockout feature when a cassette is full or not present; prompt notification to the Department of cancelled service contracts so the Department has a current status of each station; and revision of the process used for the certification of emissions inspectors. All requirements specified in the Department's follow-up letter to the manufacturers have been satisfactorily

completed. All on-going activities are also proceeding more completely and effectively than in the past, and the quality of performance has similarly improved.

2. INSPECTOR CERTIFICATION/RECERTIFICATION

Although mentioned above, the program to certify emissions inspectors warrants a separate discussion. In order for a candidate to become a certified emissions inspector, he must receive training from a manufacturer's technician associated with the analyzer installed at the licensed inspection station where he works. The manufacturer is responsible for conducting the training and certifying to the Department that the prospective inspector has been trained and is sufficiently proficient in the use of the analyzer. Department regulations go on to state that the Department shall issue the "Emissions Inspection Certification". Over the past eight years, and due to resource reductions, the manufacturers were allowed to conduct the training **and** to issue the Certificates. Such a digression from the letter of the regulation eventually caused a number of oversight and quality control problems to occur. Since each manufacturer was given a block of certification numbers, they distributed them indiscriminately, sometimes several numbers to the same person.

This situation created a database nightmare where up to 30,000 certified inspectors were logged into the inspector file. With 2400 inspection stations, this represented an average of over 12 certified inspectors at each location. This was considered to be clearly inflated from what intuitively was presumed to be a much lower number. Upon further examination, it was found that a more reasonable 13,000 inspectors were certified in the I/M program. The remedy decided upon was for the Department to regain control of the certification process. As such, the Department began reissuing certifications in late 1990 and appears to be operating more effectively. Again considering the limitations of staff resources, it was decided to only reissue certifications when the individual is a new hire or new to the station (even if he was certified on another manufacturer's analyzer), when the inspector is being trained on a different analyzer, when a new station is licensed, or if the individual has not performed inspections for some time and has forgotten his certification number. By so doing we are able to change over to a more effective monitoring function using existing staff. Since it was initiated, over 2000 new certifications have been issued, most of which are entirely new to the program.

3. IMPROVEMENTS IN DATA QUALITY, COLLECTION, AND SYSTEMS

In the Department's 1989 Annual Report, a number of issues were discussed relative to data quality, data collection, and data systems. Several problem areas were identified in each of the above categories, each having different causes and solutions. A number of corrective strategies were in progress at the time and implemented since then. Some problems dealt with the performance of the analyzer manufacturers, as highlighted above; while some required a number of internal systems fixes. Examples of the former include a condition where data loss was possible at the analyzer because no lockout feature existed to prevent additional inspections from occurring when a cassette tape was full. Any tests performed after the cassette was full resulted in the fact that no additional inspections would be recorded until the service representative replaced the tape. The remedy involved a relatively simple software change to cause the lockout.

Data loss was also thought to occur when the inspection station could physically turn a cassette tape over when full to record on the reverse side. While this feature was designed by the manufacturer for just such a purpose, they failed to even check the reverse side of full tapes during processing. The lockout will coincidentally correct this problem, as well. Other reasons which caused corrupt data to be submitted to the Department by the manufacturers or caused the loss of data altogether, has to do with poor accounting and quality control practices on the part of the manufacturer. They sometimes would not pick up the data from the analyzer as they are required to do on a monthly basis. If they picked up the cassette, it occasionally was physically lost -- for over a year in some cases. Once picked up, no logging system existed for most manufacturers to account for all their known customers. Cassette tapes were then sent to a corporate computer center where the data on these mini-cassettes were transcribed onto a 9-track tape. No accounting system existed to track how many cassettes were received against the number that should have been expected, in order to provide feedback to their field office of any deficiencies. At the corporate computer centers, the data on the 9-track tapes were required by the Department to receive quality control before being submitted to the Department. This occurred rarely, if ever at all. As a result of the Department's efforts to meet with the manufacturers and resolve these problems through the Fall of 1990 and into early 1991, all of these issues are satisfactorily being addressed. All in all, the Department's efforts to identify and resolve what were found to be controllable data capture issues will continue in future years to improve the efficiency and effectiveness of data capture and data quality. Accordingly, the current year's data continues to suffer much the same problem as past annual reports, but is the best available data given the circumstances.

The following is a discussion of a number of data systems fixes the Department itself was able to make. The Department focused its efforts on data capture and data reporting issues and their significance with respect to operations (i.e., compliance). During the 1990 program year the Department began actively enforcing the data reporting requirements contained within the Agreement between the Department and each manufacturer and the Technical and Performance Specifications. To this end, any monthly submittal of the 9-track data tape which did not satisfy even the basic labelling requirements were sent back to the manufacturer with a letter of admonition. In cases where data submittal deadlines were not adhered to, repeated telephone calls were made to appropriate corporate managers until compliance was achieved. In cases where repeated violations of data submittal requirements were observed, formal notices of intent to assess penalties were issued.

Once the tape labelling requirements and deadlines for submittals were addressed to the satisfaction of the Department, the focus was then brought to the contents of the monthly data tapes. The data were scrutinized to ensure that the submittals contained data only for the reporting month. This was done through the development of a computer program, written by the Information Systems Branch, which segregated the data on the monthly submittal tape into a series of files based on the month and year. It was observed that all four manufacturers submitted tapes which contained data spanning anywhere from two to twelve months. One of the manufacturers' submittal appeared to have data spanning a 4-week period which coincided with the end of one calendar month and the beginning of the next calendar month. Most of the other manufacturers submitted tapes of data primarily from the month of submittal, but with a host of "straggler" data mixed in as well. In the case of a June, 1990 submittal, the straggler data comprised as much as 24% of the data on the tape, with approximately 7% of the data being from the previous year.

What became apparent, after correspondence and repeated discussions with the various manufacturers, was that there was little or no data quality control with respect to what month the data were generated and written onto the 9-track for submittal to the Department. It had become standard practice that whatever data cassettes were received in-house were then loaded onto whichever 9-track tape was due for submittal. Department efforts were then focused on working with and educating the data managers and field service managers as to how data collection in the field must coincide appropriately with data submittal schedules. The corrective measures necessary for each manufacturer varied, based on each company's circumstances. One manufacturer was faced with reconstructing its entire data management system, while another only had to make fine-tuned adjustments in its data cassette collection procedures in the field. As with the data labelling

requirements, in cases where apparent cooperation or adequate responses was not forthcoming, formal notices of intent to assess penalties were issued.

At the Department's end, it was necessary to develop additional procedures and computer applications to process the monthly data tape submittals, as well as "straggler" data. Overall, these procedures require that manufacturers scrutinize their data, organize it in an acceptable, streamlined fashion, and account to the Department as to how much of the data for each month were captured, and why certain data were not captured (e.g., station closed, data cassette lost or broken). These procedures have been implemented and will be used to analyze the 1991 data. With the new procedures in place, coupled with vigilant enforcement of the requirements, the data sets for subsequent years will have better quality control, a higher data capture rate, and will be more organized and accessible with respect to month for easier data retrieval and analysis.

4. UNFINISHED BUSINESS

A number of programmatic and operational activities were not completed due to resource limitations. One includes the development of a policy which articulates the Department's authority to take enforcement action against individual inspection stations if they are found to have an analyzer that has not been maintained or calibrated, as required. A similar activity was planned for compliance and enforcement as it relates to certified inspectors who fail to demonstrate their knowledge of proper inspection procedures or fail to demonstrate their proficiency in performing an inspection with the emission analyzer. It was also intended to establish critical links between the I/M audit database and the inspection transaction file for compliance purposes. Again, given available resources and the upcoming demands for the Enhanced I/M Program, it is unlikely that these necessary, but very time-consuming, activities will be implemented until the Enhanced program is initiated.

* APPENDIX A & B COULD NOT BE REPRODUCED BUT ARE AVAILABLE FOR VIEWING AT DEP'S BOSTON OFFICE.

App C

M E M O R A N D U M

TO: Bob Boisselle

THRU: James Neely

FROM: Leah Weiss

DATE: April 4, 1991

RE: Request for Data for 1990 I/M Annual Report

In order to fulfill the reporting requirements for the 105 Grant, certain data from the I/M Transaction File need to be processed by Information Systems and analyzed by the Area Programs Implementation Branch. Therefore, we are requesting that the following statistics be generated, based on the I/M Transaction File (across all emission analyzer types) for the period January 1 - December 31, 1990:

1. Total Number of Inspection Transactions.

2. Total Number of Initial Emissions Inspections Performed. This involves totalling the number of "I"s in the "Test Type" field for all analyzer types for all vehicles for which the model year ("Veh Year" field) is 1976 or greater. Not included in this category are vehicles whose "Fuel Type" is "D" nor whose "Vehicle Type" is "C", "D", or "E".

3. (a) Total Number of Vehicles Exempted from the Emissions Inspection. This involves adding up the number of transactions for which the model year is 1975 or less, or "Fuel Type" equals "D", or "Vehicle Type" equals either "C", "D", or "E."

   (b) Total Number of Properly Exempted Vehicles. This involves counting the number of vehicles described in #3 (a) above for cases where "Vehicle Year" equals 1975 or less and "Vehicle Type" equals "E".

   (c) Total Number of Vehicles Exempted from the Emissions Inspection but should not have been Exempted. This involves counting the number of vehicles described in #3 (a) above for cases where "Vehicle Year" equals 1976 or greater and "Vehicle Type" equals "E".

   (d) Total Number of Diesel Vehicles Inspected. This involves counting the number of vehicles described in #3 (a) above for cases where "Vehicle Type" equals "D".

4. (a) Total Number of Vehicles Receiving Initial Emissions Inspections. There has been a trend of one vehicle receiving multiple, consecutive initial inspections. Therefore, we would like to identify the number of vehicles receiving initial inspections. This involves counting (and totalling) the "I" in the "Test Type" field for the conditions described in #2 above, only if the characters in the "Plate Num" field are not identical.

(b) Breakdown of Total Number of Vehicles Receiving Initial Emissions Inspections by Cutpoint Category: This involves a breakdown of the data requested in #4 (a) above for the following cutpoint categories:

Vehicle Year	No. of Initial Inspections
1981 and greater	
1980	
1976-1979	

5. Pass/Fail Status of the Vehicles Receiving Initial Emissions Inspections. Maintaining the same format and conditions described in #4 (a) and (b) above, the pass/fail status should be ascertained, based on emissions testing only (HC and/or CO failures). NOTE: WE WANT TO BE ABLE TO ASCERTAIN THE NUMBER OF INITIAL PASSES, SO PLEASE KEEP TRACK OF ALL TOTALS. Failures in RPM or CO2 are not counted as emissions failures, and should be tallied separately. Failures in either CO2 or RPM supersedes a failure in CO and HC, and the transaction should not be counted as an emissions failure, no matter what the readings are in the HC and CO fields, and if they appear to be failures. Reporting of the data should be as follows:

Vehicle Year	# Initial Inspections	# Initial Passes	# Emission (HC/CO) Failures	#CO2/RPM Failures
1981+				
1980				
1976-1979				

6. (a) Number of Vehicles which Failed Initial Emissions Inspection and Subject to a Retest. Involves totalling the number of vehicles which have failed an initial emissions test (as described in #5 (a) and (b) above) and was subject to a subsequent retest ("R" in the "Test Type" field). This includes matching the initial test and retest by license plate number, and reporting as follows:

Vehicle Year	# Initial Emission Inspections Failures	# Retested Vehicles
1981+ greater		
1980		
1976-1979		

(b) Pass/Fail Status of Retested Vehicles. For the vehicles selected out as described in #6 (a) above, the pass/fail status should be ascertained, based on emissions testing only (HC and/or CO failures). Failures in RPM or CO2 are not counted as emissions failures, and should be tallied separately. Failures in either CO2 or RPM supersedes a failure in CO and HC, and the transaction should not be counted as an emissions failure, no matter what the readings are in the HC and CO fields, and if they appear to be failures.

(c) Total Number of Retested Vehicles which were Exempted on the Retest. This involves counting the number of vehicles described in #6 (a) above for cases where "Vehicle Type" equals "E".

Reporting of the data for #6 (b) and (c) should be as follows:

Vehicle Year	# Retested Vehicles	# Retest Passes	# Retest Emissions (HC/CO) Failures	# Retest Exempts
1981+				
1980				
1976-1979				

I understand that the data set for calendar year 1990 is complete and ready to be processed. This request differs from last year's annual report request in that the data breakdowns requested in sections #3 and #6 are a bit more extensive, and may require pulling those data off into one or two separate files which may need to be processed separately. Since those data subsets are relatively small, I expect that the extra effort involved would be minimal. We would like to have this data processed and available to us by May 6, 1991. If you anticipate any problems in processing this request, please let us know as soon as possible. Thank you for your continued cooperation.

The format of the individual inspection transaction records is:

Field	Length	Column
Station Number	7	1-7
Date (MMDDYY)	6	8-13
Inspector Number	5	14-18
Type of Test I for Initial R for Retest C for Challenge	1	19
Vehicle Make	5	20-24
Vehicle Year	2	25-26
Odometer (thousands)	4	27-30
Plate Number	8	31-38
Fuel Type G for Gas D for Diesel	1	39
Vehicle Type A for Passenger Auto B for Light Duty Truck C for Motorcycle D for Heavy Duty Truck E for Other/Exempt	1	40
Air Pump Y for Yes N for No	1	41
HC PPM	4	42-45
CO% X 100	4	46-49
CO2 X 100	4	50-53
Sticker Number	8	54-61
The following 16 Pass/Fail bytes are coded 0 for Pass 1 for Failure		
CO2%	1	62
CO%	1	63
HC	1	64
Fuel Filler Neck	1	65
Catalytic Converter	1	66
Other	1	67
Bumpers/Fenders	1	68
Number Plates	1	69
Window/Wipers	1	70
Horn	1	71
Steering System	1	72
Muffler/Exhaust	1	73
Turn Signals	1	74
Head/Tail Lights	1	75
Brakes	1	76
RPM	1	77

App D

MASSACHUSETTS EMISSIONS INSPECTOR CERTIFICATION

(effective January 1 ,1988)

INSPECTOR NO.	

APPLY PRESSURE AND PRINT CLEARLY IN EACH BOX FROM LEFT TO RIGHT

first middle initial last

1. Name:

no. street

Home Address:

City or Town: Zip

2. Drivers License No.

3. R.M.V. STATION LICENSE NO.

4. EMPLOYED AT:

Address:

City or Town: Zip

5. Inspector is on the payroll records and employed on the premises of this station for a minimum of 20 hours per week.

☐ yes ☐ no.

6. The Inspector has received training in the operation of one of the following analyzers:

☐ Allen ☐ Bear ☐ Hamilton ☐ Sun

7. M.G.L. 111,S142J(f) provides for the certification of motor vehicle inspection personnel. The Inspector of this certification agrees to comply with the rules and regulations promulgated by the Registry of Motor Vehicles and the Department of Environmental Quality Engineering. Failure to comply may result in the suspension of this certification. The Inspector agrees to comply by signing below:

_____ Date: _____

(Signature of Inspector)

8. Trained by: _____ Date: _____

(Signature)

9. Please notify the Department of Environmental Quality Engineering in writing of any changes in employment status or call 617-292-5630.

10. This form is the property of the Inspector and must be retained by him/her upon termination of employment.

DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING
One Winter Street- Air Quality Control- 8th Floor
Boston, Massachusetts 02108

Distribution: White-Inspector/ Yellow- D.E.Q.E./ Pink- Equip. Mfg.

30M-4/88-803471

The Commonwealth of Massachusetts

App E

INSPECTION AND MAINTENANCE (I/M) PROGRAM
ANALYZER AUDIT FORM

lease Print Clearly:

TATION NUMBER_____ ANALYZER MFR. _____

TATION NAME _____ STATION OWNER/OPERATOR_____

DDRESS_____ OWNER/OPERATOR NO._____

ITY/TOWN_____ STATE AUDITOR_____

CTUAL DATE_____ AUDIT TANK SERIAL NO._____

YPE OF AUDIT (CHECK ONE): INITIAL AUDIT ☐ 1ST REAUDIT ☐ 2ND REAUDIT ☐

INITIAL CHECK

ITEM	PEF/PROPANE	INPUT	RESPONSE	%ERROR +4 -7
HC	X			
CO	//////////			

RECHECK

ITEM	INPUT	RESPONSE	%ERROR +4 -7
HC			
CO			

Check when completed: ELECTRICCAL ☐

Check when completed:
GASCAL ☐
LEAKCHECK ☐
ELECTRICCAL ☐

CONVERSION FORMULAS:

1. PEF_____ X PROPANE (PPM) = _____ PPM AS HEXANE
(INPUT VALUE FOR HC ONLY)

2. $\frac{\text{RESPONSE - INPUT X 100}}{\text{INPUT}}$ = % ERROR

FINAL AUDIT RESULTS:

PASS _____

FAIL _____

CIRCLE FAILED ITEMS: HC CO PROBE TIP DATE
LEAKCHECK PRINTER OTHER _____

FAILED ANALYZER SERIAL NUMBER_____

istribution: Original (white) - Auditor sends to DEP
1st (yellow) copy - Auditor copy
2nd (pink) copy - Leave at station - Analyzer Mfr. copy to be picked up during service call
3rd (blue) copy - Station copy

EP Address: One Winter Street, 8th Floor, Boston, MA 02108 Attn:I/M Audits

Rev. 2/91

The Commonwealth of Massachusetts

App F

INSPECTION AND MAINTENANCE (I/M) PROGRAM ANALYZER AUDIT CEASE AND DESIST ORDER

Rev. 2/91

TO THE STATION OWNER/OPERATOR:

Compliance testing conducted by the Commonwealth of Massachusetts indicates that your analyzer does not comply with the technical performance specifications required pursuant to Department of Environmental Protection (DEP) regulation 310 CMR 7.20 and Registry of Motor Vehicle regulation 540 CMR 4.08. The analyzer continued to exceed established tolerance limits of +4% thru -7% after calibration, and therefore cannot accurately measure emissions. Therefore, pursuant to the above mentioned regulations, YOU MUST IMMEDIATELY CEASE AND DESIST CONDUCTING STATE EMISSIONS INSPECTIONS. You may, however, continue to conduct safety only inspections.

It is your responsibility to notify the analyzer manufacturer regarding the audit failure to arrange for repair service. Once an authorized service technician has completed the necessary repairs, and certifies that your analyzer is working within the specified tolerances by signing and dating this order, you may resume performing emissions inspections.

Failure to comply with this order will result in a hearing and possible suspension or revocation of your inspection station's license, pursuant to 540 CMR 4.08. Failure to comply with this order may also result in the temporary suspension or permanent revocation of the Certified Inspector(s) responsible for such failure pursuant to 310 CMR 7.20.

TO BE COMPLETED BY AUTHORIZED STATE AUDITOR:

STATION NUMBER:_____ ANALYZER MFR:_____

STATION NAME:_____ AUDIT TANK SERIAL NO:_____

CITY/TOWN:_____

NEXT STICKER TO BE ISSUED:_____

FAILURE ITEMS - circle cause(s):

HC, CO, DATE, PRINTER, PROBE TIP LEAKCHECK, OTHER_____

AUDITOR'S SIGNATURE:_____ ACTUAL DATE/TIME:_____

STATION OWNER/OPERATOR'S SIGNATURE:_____

TO BE COMPLETED BY AUTHORIZED SERVICE TECHNICIAN:

I certify that I have made the necessary repairs on the subject analyzer and that it is operating within the specified tolerances.

SERVICE REPRESENTATIVE'S SIGNATURE:_____

DATE/TIME:_____ COMPANY REPRESENTING:_____

REPAIR CODES (SERVICE REPRESENTATIVE - Please check the appropriate item(s) requiring repair):

PROBE TIP/HOSE (PT) ☐ LEAK CHECK (LC) ☐ VACUUM SWITCH (VS) ☐
DATE/TIME (AT) ☐ FILTER BOWL (FB) ☐ ELECTRICAL CAL (EC) ☐
BENCH (B) ☐ OTHER (O) (Please specify):_____

Distribution: Original (white) - Auditor sends to DEP
1st (yellow) copy - Auditor copy
2nd (pink) copy - Leave at station - Analyzer Mfr. Service Representative fills out & returns to DEP
3rd (blue) copy - Station copy - Should be kept attached to pink copy UNTIL Service Representative makes repairs and completes form

DEP Address: One Winter Street, 8th Floor, Boston, MA 02108 Attn:I/M Audits